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FM 6-81

DEPARTMENT OF THE ARMY FIELD MANUAL

155-MM HOWITZER, M1 TOWED

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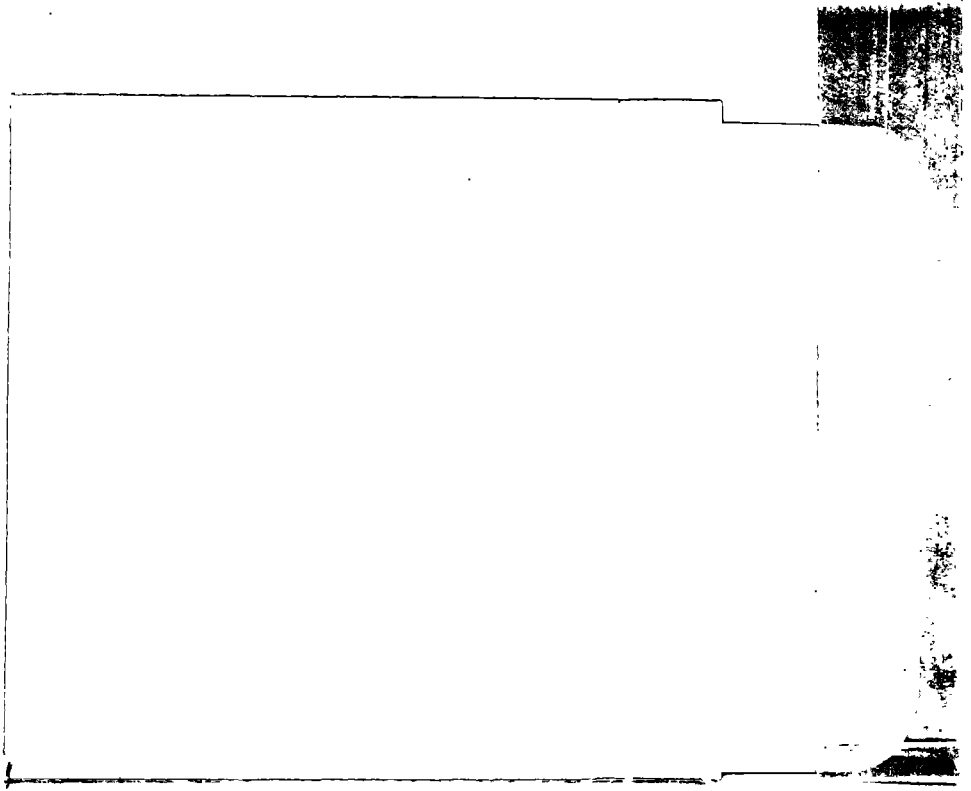
HEADQUARTERS, DEPARTMENT OF THE ARMY
MARCH 1962



FIELD MANUAL
No. 6–81

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C., *28 March 1962*

155-MM HOWITZER, M1 TOWED

	Paragraphs	Page
CHAPTER 1. GENERAL	1–3	3
2. ORGANIZATION	4, 5	8
3. SECTION DRILL		
Section I. General	6, 7	10
II. Preliminary commands and formations	8–13	11
CHAPTER 4. PREPARING THE HOWITZER FOR FIRING AND TRAVELING		
Section I. Preparations for firing	14–17	21
II. Preparations for traveling	18, 19	24
CHAPTER 5. DUTIES IN FIRING		
Section I. Indirect laying	20–30	26
II. Direct laying, general	31–34	67
III. Direct laying, duties	35–40	75
CHAPTER 6. TECHNIQUES AND SITUATIONS THAT REQUIRE SPECIAL ATTENTION	41–49	82
7. BORESIGHTING AND BASIC PERIODIC TESTS		
Section I. General	50, 51	95
II. Boresighting	52–57	97
III. Basic periodic tests	58–62	127
CHAPTER 8. MAINTENANCE AND INSPECTIONS	63–73	137
9. DECONTAMINATION OF EQUIPMENT	74–77	143
10. DESTRUCTION OF EQUIPMENT	78–80	146
II. SAFETY PRECAUTIONS	81–84	148

*This manual supersedes FM 6–81, 20 February 1961.

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	Paragraphs	Page
CHAPTER 12. TRAINING		
Section I. General	85–88	151
II. Minimum training schedule	89–91	153
III. Tests for qualification of gunners	92–104	158
APPENDIX. REFERENCES		182
INDEX		185

CHAPTER 1

GENERAL

1. Purpose and Scope

a. This manual is a guide to assist commanders in developing the sections of towed 155-mm howitzer M1 firing batteries into efficient, smooth-working teams that have a sense of discipline that will impel them to operate effectively under the stress of battle. This manual prescribes individual duties and section drills, inspection and maintenance drills, tests and adjustments for sighting and fire control equipment, and methods for the destruction and decontamination of equipment. The material presented herein is applicable without modification to both nuclear and nonnuclear warfare.

b. Users of this manual are encouraged to submit recommended changes or comments to improve the manual. Comments should be keyed to the specific page, paragraph, and line of the text in which change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be forwarded direct to Commandant, U.S. Army Artillery and Missile School, ATTN: AKPSITL, Fort Sill, Okla.

2. Definitions and Terms

a. Cannon. Cannon is a weapon larger than small arms that throws its projectile by the use

of an explosive. Cannon includes guns, howitzers, and mortars. The term also includes that portion of an artillery weapon required to fire a projectile, the tube, breech mechanism, and firing mechanism of an artillery weapon.

b. Gun. In artillery, the term "gun," generally means cannon above .30 caliber (length 30 times the bore), or relatievly long barrel, operating with a relatively low angle of fire and having a high muzzle velocity.

c. Howitzer. Normally, a howitzer is a cannon with a medium length barrel between that of a mortar and a gun in length, operating with a relatively high angle of fire and having a medium muzzle velocity.

d. Service of the Piece. Service of the piece is the operation and maintenance of a weapon or other equipment by its crew.

e. Piece. Throughout this manual the term "piece" is used to mean the 155-mm howitzer.

f. Section. Tables of organization and equipment prescribe the *personnel* and *equipment* comprising each section of a battery (figs. 1 and 2). In this manual, the term "section" is often used to designate only the personnel required to serve the howitzer and equipment of one section.

g. Coupled. A piece is coupled when it is attached to its prime mover and all braking and lighting connections are in place.

h. Uncoupled. A piece is uncoupled when it is detached from its primer mover.

i. Front. For the purpose of conducting drills prescribed herein, the front in a section, with the piece coupled, is the direction in which the prime

Figure 1. 155-mm howitzer section, towed.

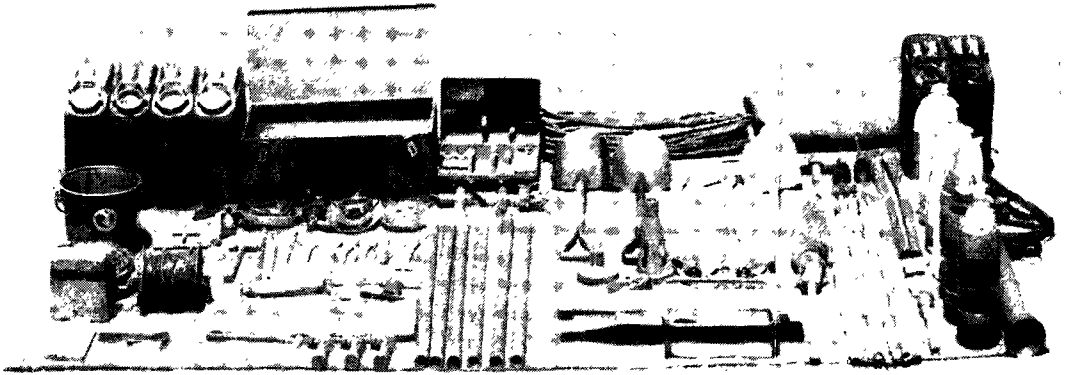

Figure 2. A method of displacing section equipment of a 155-mm howitzer, towed.

mover is headed; with the piece uncoupled, the front is the direction in which the muzzle points. However, for determining the right or left of the piece, coupled or uncoupled, the front is the direction in which the muzzle points.

j. Right (Left). The direction right (left) is the right (left) of one facing to the front.

k. In Battery. A piece is said to be *in battery* when the tube is in the normal firing position.

3. References

Publications pertaining to the 155-mm howitzer M1, towed, and auxiliary equipment, covering related matters not discussed in detail in this manual, are listed in the appendix.

CHAPTER 2

ORGANIZATION

4. Composition of the Howitzer Section

a. The howitzer section consists of section personnel, a 155-mm howitzer M1, the prime mover, and auxiliary equipment.

b. The personnel of the howitzer section consists of—

(1) A chief of section (CS).
(2) A gunner (G).
(3) An assistant gunner (AG).
(4) Seven cannoneers, numbered 1 to 7, inclusive.
(5) A driver (D).

c. Section equipment is prescribed in the appropriate tables of organization and equipment (TOE's) and standard nomenclature lists (SNL's) as listed in the appendix.

5. General Duties of Personnel

a. Chief of Section. The chief of section is the noncommissioned officer in command of the entire section. He is responsible to the battery executive for—

(1) Training and efficiency of personnel.
(2) Performance of duties listed under section drill, duties in firing, testing and adjustment of sighting and fire control equipment, and inspection and maintenance of

all section equipment, including the prime mover.

(3) Observance of safety precautions.

(4) Preparation of field fortifications for protection of equipment, ammunition, and personnel.

(5) Camouflage discipline; local security; and radiological, biological, and chemical security discipline.

(6) Maintenance of the gun book.

(7) Police of the section area.

(8) Storage, handling, and preparation of ammunition for firing.

b. Gunner. The gunner assists the section chief in carrying out the duties specified in *a* above. The gunner's specific duties are prescribed in the appropriate chapters of this manual.

c. Assistant Gunner. The assistant gunner assists the gunner and in an emergency acts as the gunner. The assistant gunner's specific duties are prescribed in the appropriate chapters of this manual.

d. Cannoneers. Cannoneers perform duties as listed in this manual and any other duties prescribed by the chief of section.

e. Driver. The driver's primary duty is to drive the prime mover of the section. He also performs maintenance and such other duties as prescribed by this manual, by the technical manual for the vehicle, or by the chief of section.

CHAPTER 3

SECTION DRILL

Section I. GENERAL

6. Objective

The objective of section drill is the attainment of efficiency: maximum precision coupled with high speed.

7. Inspection

a. To develop maximum efficiency and to prevent injuries to personnel and equipment, the drills prescribed in this manual must be observed. Section drill should be conducted in silence except for commands and reports. The section must be drilled until reactions to commands are automatic, rapid, and efficient.

b. Errors are corrected immediately. Each member of the section must be impressed with the importance of reporting promptly to the chief of section any errors or safety hazard discovered either before or after the command to fire has been given. The chief of section reports errors immediately to the executive. The authority to Command CEASE FIRING is delegated to any member of the unit who observes a safety hazard.

c. The battery executive or his designated representative supervises the drill to insure that instructions are carried out and that maximum efficiency is obtained.

d. Duties should be rotated during training so that each member of the howitzer section can perform all the duties within the section. In addition, battery overhead personnel not assigned specific duties during drill periods should be trained in the fundamentals of section drill in order that they will be capable of functioning efficiently with a howitzer section if required.

Section II. PRELIMINARY COMMANDS AND FORMATIONS

8. To Form the Section

a. To Fall In. The chief of section takes his post. On the command of execution, the section forms in a single rank at close interval, centered on and facing the chief of section at a distance of 3 paces (fig. 3). Higher numbered cannoneers, if present, form in order between number 7 and the driver. The chief of section may indicate in his preparatory command the place and direction (always facing the piece) the section is to form. At the first formation for a drill or exercise, the caution "As howitzer section(s)" precedes the command. The commands are: FALL IN; or 1. IN REAR OF YOUR PIECE. 2. FALL IN; or

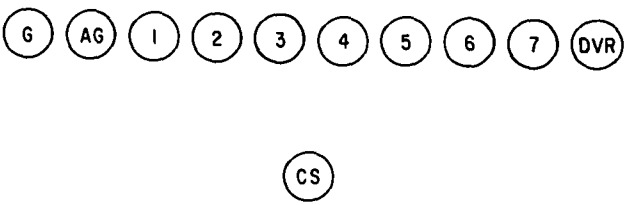

Figure 3. Howitzer section in formation.

1. ON THE ROAD FACING THE PARK. 2. FALL IN. Execution is as follows: The howitzer section moves at double time and forms at close interval, at attention, guiding on the gunner (fig. 3).

b. To Call Off. The section being in formation, the command is CALL OFF. At the command, all personnel in ranks except the gunner execute eyes right. The section then calls off in sequence, "Gunner, AG, 1, 2, 3, 4, 5, 6, 7, Driver." As each man calls out his designation he turns his head smartly to the front.

9. Posts of the Section

The command is 1. CANNONEERS, 2. POSTS. The command is general and is applicable whether the section is in or out of ranks, at a halt, or marching. All movements are executed at double time and are terminated at the position of attention. Higher numbered cannoneers, if present, take posts as prescribed by the chief of section.

a. Piece Coupled. The section moves to posts as shown in figure 4. All personnel face to the front and are alined 2 feet outside of and parallel to the sides of the prime mover.

b. Piece Uncoupled, Not Prepared for Action. The section moves to posts as shown in figure 5. All personnel face to the front and are alined 2 feet outside of and parallel to the wheels, except for the chief of section, who stands 3 paces to the rear of the junction of the trails.

c. Piece Prepared for Action. The section moves to posts as shown in figure 6. All personnel face to the front.

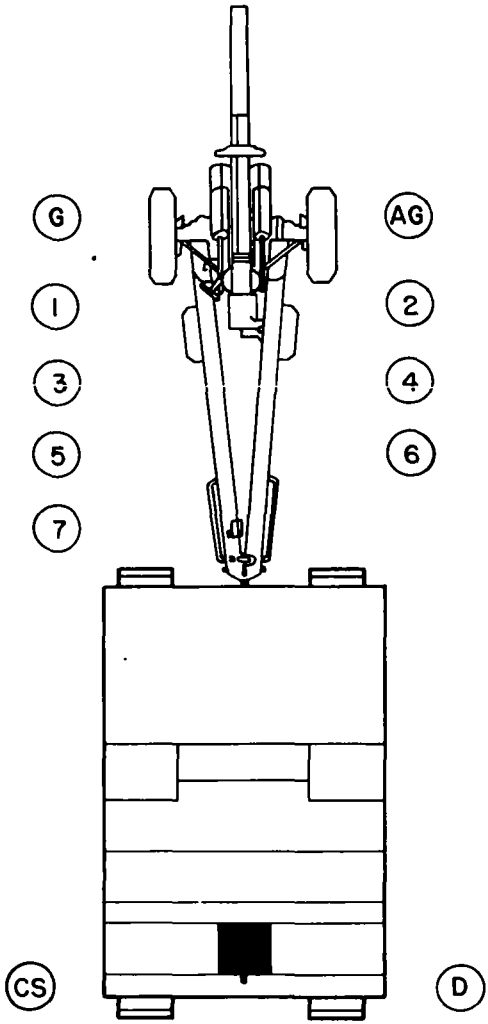

Figure 4. Posts of section, piece coupled.

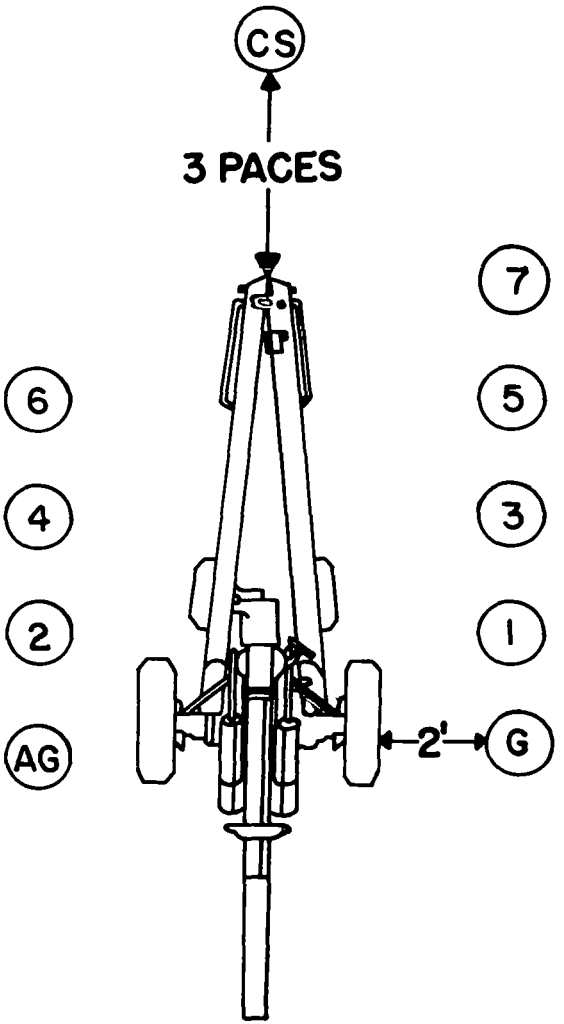

Figure 5. Posts of section, piece uncoupled, not prepared for action.

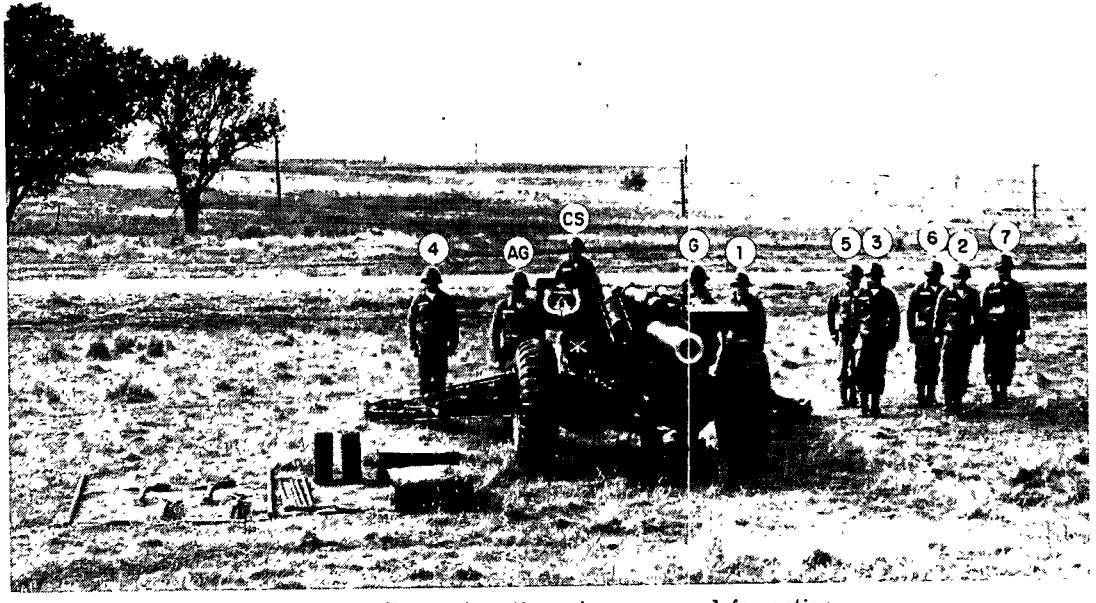

Figure 6. Posts of section, piece prepared for action.

10. To Change Posts

The posts of section personnel should be changed frequently to acquaint the members of the section with all duties and to lend variety to the drill. The section being *in formation*, the commands are 1. CHANGE POSTS, 2. MARCH, or 1. SECTION, CHANGE POSTS, 2. MARCH.

a. At the command 1. CHANGE POSTS, 2. MARCH, all cannoneers, except the driver (or the highest numbered cannoneer) and the gunner, take two left steps thus placing them at the post of the next higher numbered cannoneer. At the preparatory command CHANGE POSTS the driver (or the highest numbered cannoneer) takes 1 pace to the rear, executes a right face, and at the command MARCH moves at double time to the post of assistant gunner. The gunner of the section stands fast.

b. At the command 1. SECTION, CHANGE POSTS, 2. MARCH, all members of the section except the leftmost member of the section take two left steps. The leftmost member moves at double time in rear of the section to the post of the gunner.

11. To Mount

To mount, the commands are 1. PREPARE TO MOUNT, 2. MOUNT, or MOUNT. If any members of the section are to remain dismounted, their designations are announced with the caution "Stand fast," given between the preparatory command and the command of execution; for example, 1. PREPARE TO MOUNT, DRIVER STAND FAST, 2. MOUNT.

a. 1. PREPARE TO MOUNT, 2. MOUNT.

(1) *Truck prime mover.* At the preparatory command, the section moves at double time

to positions similar to those shown in figure 4 for a tractor prime mover. At the command of execution, the driver and chief of section take positions at the rear of the truck, on the left and right, respectively, where they can observe and assist in loading. The two columns mount in order from front to rear and take seats as in figure 7. Each cannoneer is assisted in mounting by the one directly behind (or in front, in the case of the last cannoneer in column) to insure promptness and prevent injuries. Prior to mounting, the chief of section and the driver verify that the howitzer is properly coupled, that personnel and equipment are aboard, and that the tailgate and safety straps are secure.

(2) *Tractor prime mover.* At the preparatory command, the section moves at double time to positions shown in figure 4. Prior to taking their posts, the driver opens the doors on the left side of the tractor and the chief of section opens those on the right side. At the command of execution, the gunner and numbers 1 through 7 mount in order, from front to rear from their respective sides, and take seats as shown in figure 8. Prior to mounting, the commander of the vehicle and the driver verify that the piece is properly coupled, that personnel and equipment are aboard, and that doors are securely closed. They then take their seats (fig. 8).

b. MOUNT. At the command MOUNT, the section executes all that is prescribed in *a* above.

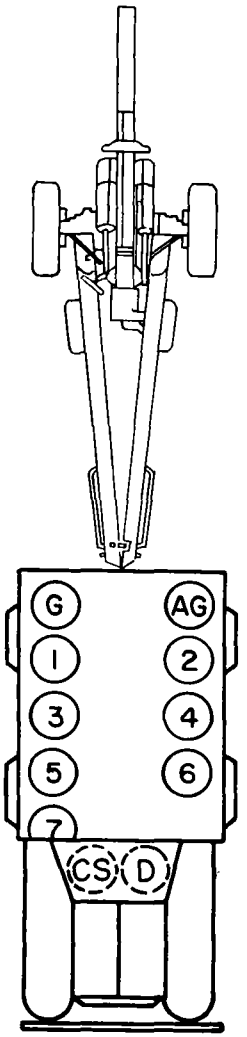

Figure 7. Section mounted, truck prime mover.

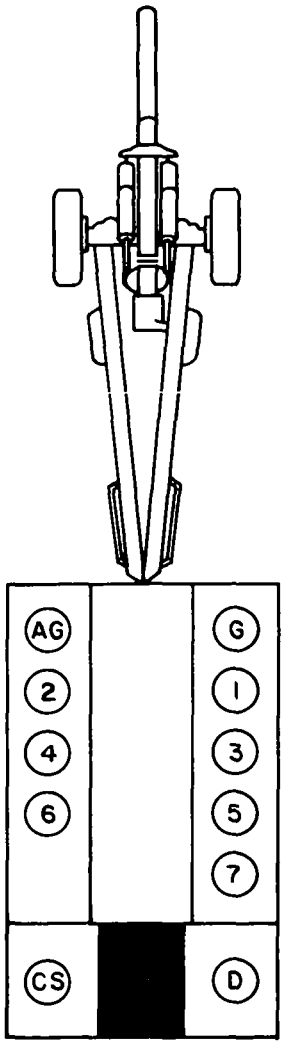

Figure 8. Section mounted, tractor prime mover.

12. To Dismount

To dismount the commands are 1. PREPARE TO DISMOUNT, 2. DISMOUNT, or DISMOUNT.

a. 1. PREPARE TO DISMOUNT, 2. DISMOUNT. At the preparatory command, members of the section assume positions from which they can dismount promptly; at the command of execution, they jump to the ground and take their posts at double time.

b. DISMOUNT. At the command DISMOUNT, the section executes all that is prescribed in *a* above.

13. To Fall Out

a. At Drill. When it is desired to give the personnel a rest from drill or to relieve them temporarily from *formation or post*, the command FALL OUT is given. The command may be given at any time and infers that the section is to remain in the drill area.

b. When Firing. When firing has been suspended temporarily but the section is to remain in the vicinity of the howitzer, the command FALL OUT is given. Men stand clear of the howitzer to insure that settings and laying remain undisturbed. During these periods, they replenish ammunition, or do other necessary work.

CHAPTER 4

PREPARING THE HOWITZER FOR FIRING AND TRAVELING

Section I. PREPARATIONS FOR FIRING

14. To Uncouple

a. The command is UNCOUPLE. At the command UNCOUPLE, members of the section take positions as shown in figures 9 and 10.

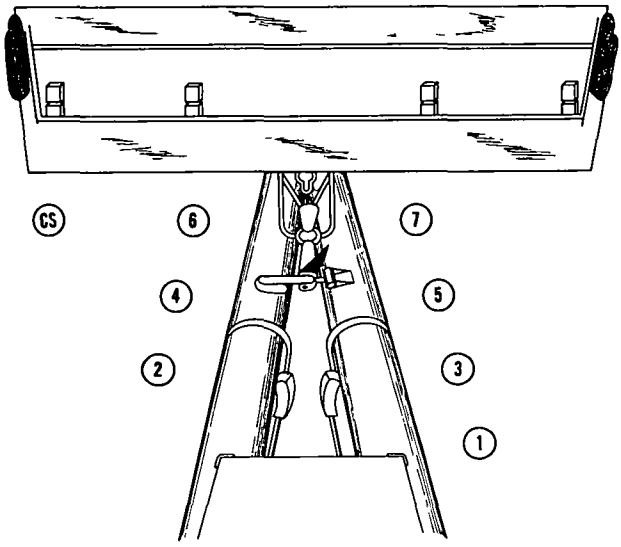

Figure 9. Section uncoupling (coupling) the piece.

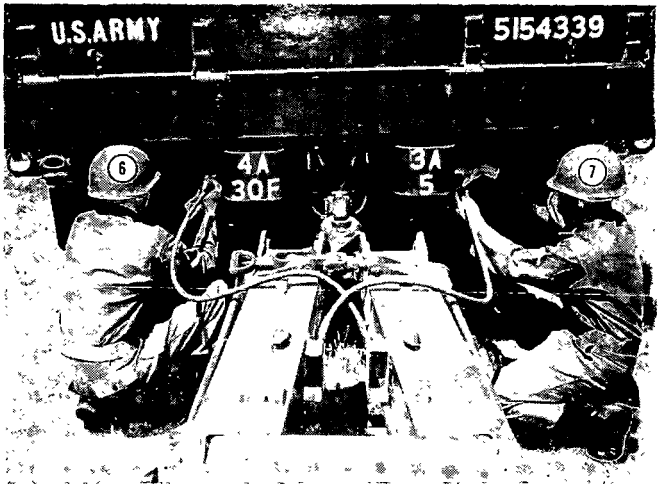

Figure 10. Nos. 6 and 7 disconnecting air hoses.

b. Individual duties in the execution of the command UNCOUPLE are shown in table I.

Table I. Duties in Uncoupling.

(Located in back of manual)

15. Direction

a. Action Front. If the command ACTION FRONT is given, assistant gunner releases the right handbrake after the piece is uncoupled. Numbers 2 through 7 then turn piece 180° in a clockwise direction and lower the trails to the ground, and assistant gunner sets the right handbrake (par. 2*i*).

b. Action Right (Left). The command is ACTION RIGHT (LEFT). The movement is executed as in ACTION FRONT, except that after the piece is uncoupled, the trail is turned 90° in the appropriate direction (par. 2*j*).

16. Movement of the Piece by Hand

The weight of the 155-mm howitzer restricts movements by hand by the howitzer section beyond those required in uncoupling, preparing for action, resuming march order, and coupling. When additional movement by hand is necessary, it must be done with additional personnel provided by, and under the supervision of, the chief of firing battery. When the piece is being moved by hand, the mechanical handbrakes must be manned to prevent an accident.

17. To Prepare for Action

a. With the piece in position uncoupled, the command is PREPARE FOR ACTION. If PREPARE FOR ACTION has not been ordered by the executive before the piece is established in the firing position, the command is habitually given by the chief of section as soon as the piece has been uncoupled. When the section has attained a high degree of proficiency, the command UNCOUPLE may be omitted. In this case, at the command PREPARE FOR ACTION, the section will perform the duties prescribed in table I and without hesitation continue with the duties given in table II. After completion of designated duties, personnel take posts as shown in figure 6. If PREPARE FOR ACTION is not desired, the caution DO NOT PREPARE FOR ACTION must be given.

b. Individual duties in the execution of the command PREPARE FOR ACTION are shown in table II.

Table II. Prepare for Action.

(Located in back of manual)

Table IIA. Duties in Firing.

(Located at back of manual)

Section II. PREPARATIONS FOR TRAVELING

18. To Prepare for Travel (March Order)

a. To prepare to resume travel, with the piece uncoupled and prepared for action, the command is MARCH ORDER. After completion of designated duties, personnel take posts as shown in figure 5.

b. Individual duties in the execution of the command MARCH ORDER are shown in table III.

c. Exceptions modifying march order duties are as follows:

(1) If firing is to be resumed shortly in another position to which the piece must be towed by its prime mover, only those operations incident to march order that are necessary for the movement of the piece and for the care and security of the equipment are performed.

(2) If the command MARCH ORDER is given while the piece is coupled, the operations pertaining to march order are completed.

(3) If coupling is not desired, a warning is included in the command as follows: MARCH ORDER "Do not couple." In this case, only sequences 1 through 11, table III, are performed.

19. To Couple

The command is COUPLE. This command is given if the piece is uncoupled and not prepared for action. The howitzer section performs only

those duties required for coupling (sequences 12 through 17 in table III).

Table III. March Order.

(Located in back of Manual)

CHAPTER 5

DUTIES IN FIRING

Section I. INDIRECT LAYING

20. Duties of Individuals

The general instructions given in paragraphs 6 and 7 on the conduct of section drill apply equally to section drill in duties in firing. For duties of the battery executive, see FM 6–40. The principal duties of individuals in the section during firing are as follows:

a. The chief of section supervises and commands his section and is responsible that all personnel of the section perform their duties properly, that all commands are executed, and that all safety precautions are observed.

b. The gunner sets the announced deflection and quadrant, centers the cross-level and longitudinal-level bubbles, lays for direction, and refers the piece.

c. AG operates the breech and primes and fires the piece.

d. No. 1 swabs and inspects the powder chamber after each round and assisted by No. 4 rams the projectile.

e. No. 2 operates the fuze setter and sets the fuzes.

f. No. 3 assists No. 6 in carrying the projectile to the piece and places powder charge in chamber.

g. No. 4 assists No. 1 in ramming the projectile.

h. No. 5 prepares the powder charge.

i. No. 6 assisted by No. 3, carries projectile to the piece.

j. No. 7 inspects and cleans the projectile and assists No. 2 in fuzing the projectile.

k. The driver, after his vehicle is unloaded, is normally directed to the truck park designated by the battery commander, he remains with his vehicle and performs maintenance operations unless otherwise directed by the chief of section.

21. Chief of Section

a. Duties. The chief of section—

(1) Assisted by the gunner, lays the piece for elevation when the gunner's quadrant is used.
(2) Measures the quadrant.
(3) Measures the site to the mask.
(4) Indicates to the gunner the aiming point.
(5) Follows fire commands.
(6) Indicates when the piece is ready to fire.
(7) Gives the command to fire..
(8) Reports mistakes and other unusual incidents of fire to the executive.
(9) Conducts prearranged fires.
(10) Records basic data.
(11) Observes and checks frequently the functioning of the materiel.
(12) Assigns duties when firing with reduced personnel.
(13) Verifies the adjustment of the sighting and fire control equipment.
(14) Checks all unused ammunition before it is replaced in containers.

b. Detailed Description of Duties.

(1) *Lays for elevation when the gunner's quadrant is used.*

(*a*) A quadrant of 361.8, for example, is set on the gunner's quadrant (fig. 11) as follows: The upper edge of the index plate is set opposite 360 on the graduated frame, and the micrometer on the index arm is turned to read 1.8. Care must be taken to use the same side of the quadrant in setting both the index plate and the micrometer knob.

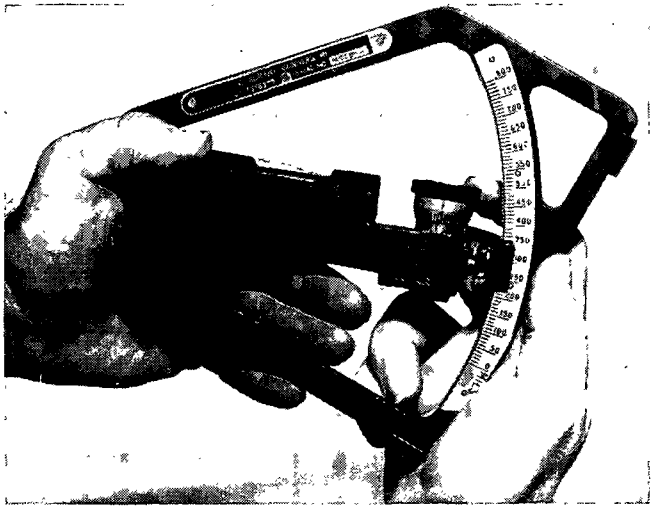

Figure 11. Setting the gunner's quadrant.

(*b*) With the announced quadrant set on the gunner's quadrant, the piece loaded, and the breechblock closed, the gunner's quad-

rant is set on the quadrant seat of the bracket on the telescope mount. The words *line of fire* must be at the bottom of the quadrant and the arrow must be pointing toward the muzzle. The chief of section must be sure to use the arrow which appears on the same side of the quadrant as the scale which he is using. He stands squarely opposite the side of the quadrant and holds it firmly on the quadrant seat, parallel to the axis of the bore. *It is important that he take the same position and hold the quadrant in the same manner for each subsequent setting.*

(*c*) The chief of section then directs the gunner to elevate or depress the piece until the bubble is centered, being careful that the last motion is in the direction in which it is more difficult to turn the handwheel. The chief of section cautions the gunner when the bubble is approaching the center, in order that the final centering may be performed accurately.

(*d*) Normally, special and calibration corrections will be added algebraically to the quadrant at the fire direction center. The quadrant, to include correction, is "Number (so-and-so), quadrant (so much)."

(2) *Measuring the quadrant.* At the command MEASURE THE QUADRANT, with the piece laid, the chief of section directs the gunner to center the cross-level bubble and then to center the longitudinal-level bubble

with the elevation knob. The chief of section then reads the quadrants set on the elevation scale and micrometer and announces it as "Number (so-and-so), quadrant (so much)." If use of the elevation scale on the telescope mount is impractical, the quadrant is measured by placing the gunner's quadrant on the quadrant seats of the breech ring where the chief of section, by raising and lowering the index arm and turning the micrometer knob, enters the bubble. He then reports the reading on the gunner's quadrant to the executive.

(3) *Measuring site to the mask.*

(*a*) The command is MEASURE THE SITE TO THE MASK. The chief of section has the gunner center the cross-level bubble. Then, sighting along the lowest element of the bore, he directs the gunner to traverse and elevate the tube until the line of sight just clears the crest at its highest point in the probable field of fire. He then directs the gunner to center the longitudinal-level bubble by turning the elevation knob. The chief of section reads the elevation set on the elevation scale and micrometer and reports to the executive, "Number (so-and-so), site (so much)."

(*b*) If use of the elevation scale on the telescope mount is impractical, the chief of section may use the gunner's quadrant in measuring the site to the mask.

(*c*) When the executive announces the min-

imum quadrant and charge or the minimum quadrant for each charge, the chief of section records it in a notebook and directs the gunner to chalk the minimum quadrant for each charge to be used on a convenient place on the shield.

(4) *Indicating the aiming point.* When an aiming point has been designated by the executive (FM 6–40), the chief of section will insure that he has properly identified the point designated. He will then indicate it to the gunner. If there is any possibility of misunderstanding, the chief of section will turn the panoramic telescope until the horizontal and vertical hairlines are on the point designated.

(5) *Following fire commands.* The chief of section will follow fire commands. He will repeat the commands as required.

(6) *Indicating when the piece is ready to fire.* When the executive can see arm signals of the chief of section, the chief of section will raise his right arm vertically as a signal that the gun is ready to fire. He gives the signal as soon as the gunner calls "Ready." When arm signals cannot be seen, the chief of section reports orally to the executive "Number (so-and-so) ready."

(7) *Giving the command to fire.* When number 1 can see arm signals made by the chief of section, the chief of section will give the command to fire by dropping his right arm sharply to his side. When his arm signals cannot be seen, he orally commands FIRE.

The chief of section will not give the signal or command to fire until all the cannoneers are in their proper places. He will require the cannoneers to stand clear of the piece until it has been firmly seated.

(8) *Reporting mistakes and other unusual incidents of fire to the executive.* If for any reason the piece cannot be fired, the chief of section will promptly report this fact and the reasons therefor to the executive; for example, "Number (so-and-so), misfire." Whenever it is discovered that the piece has been fired with a mistake in laying, the chief of section will report this at once; for example, "Number (so-and-so) fired 40 mils right." Whenever the gunner reports that the aiming posts are out of alinement with the sight, the chief of section will report this and request permission to realine the aiming posts if the misalinement is due to progressive shifting of the trails caused by firing. Likewise, he promptly reports other unusual incidents that affect the service of the piece.

(9) *Conducting prearranged fires.* Whenever the execution of prearranged fires is ordered, the chief of section will conduct the fire of his section in conformity with the prescribed data.

(10) *Recording basic data.* The chief of section will record, in a notebook, data of a semipermanent nature, such as minimum quadrant; aiming points used and their deflections; prearranged fires when section

data sheets are not furnished; safety limits in quadrant and deflection; date, hour, and number of rounds fired; and calibration data. During firing, the chief of section should also record essential elements of the fire command, such as deflection, quadrant, charge, and fuze setting, to preclude requesting repeat-backs from the executive.

(11) *Observes and checks functioning of the materiel.* The chief of section closely observes the functioning of all parts of the materiel during firing. Before the piece is fired, he insures that the recoil mechanism contains the proper amount of oil; thereafter he carefully observes the functioning of the recoil system. He promptly reports to the executive any evidence of malfunctioning (TM 9–331A).

(12) *Assigning duties when firing with reduced personnel.* Whenever the number of personnel of the section serving the piece is temporarily reduced below that indicated in this manual, the chief of section will combine the duties to best facilitate the service of the piece. Understrength units, loss of cadremen, casualties, and various details will necessitate the howitzer section operating with a reduced number of personnel to the extent that it is almost normal for cannoneers to double up on duties. In combat or in field training, cannoneers must be assigned to work in shifts to permit 24-hour operations.

(13) *Verifying the adjustment of sighting and*

fire control equipment. See chapter 7 and TM 9–331A for detailed instructions on testing and adjusting sighting and fire control equipment.

(14) *Checking all unused ammunition before it is replaced in containers.* The chief of section personally checks all unused ammunition to see that powder increments are present in proper condition and assembled in numerical order and that projectiles are of the proper lot number. He also checks to see that the lot number on the ammunition corresponds to the lot number on the container in which it is replaced.

22. Gunner

a. The Gunner—

(1) Centers the cross-level and longitudinal level bubbles on the telescope mount.
(2) Lays the piece for direction.
(2) Lays the piece for direction.
(4) Alines the aiming posts, assisted by number 5.
(5) Sets a common deflection on a common aiming point after the piece has been laid.
(6) Sets the deflection.
(7) Sets the quadrant.
(8) Refers the piece.
(9) Uses proper sight picture for aiming post displacement.
(10) Calls "Ready."

b. Detailed Description of Duties.

(1) *Centers the cross-level and longitudinal level bubbles on the panoramic telescope*

mount. The gunner centers the level bubbles on the telescope mount as part of all operations that involve the use of the panoramic telescope except as described for direct fire (par. 35). These bubbles are centered prior to using the telescope and the level of the mount is verified before firing.

(2) *Lays the piece for direction.* With the piece in position but not laid for direction, the gunner zeros the sight as follows:

(*a*) Alines the movable azimuth micrometer index (gunner's aid) of the sight with the right (fixed) index (fig. 12).

(*b*) Loosens the slipping micrometer locking nut by turning it counterclockwise, firmly holding the azimuth micrometer knob with his right hand (fig. 13).

(*c*) Slips the slipping micrometer into coincidence with the left index (fig. 14), tightens the locking nut (fig. 15), and verifies the alinement of zero on the scale with the left index.

(*d*) Turns the azimuth micrometer knob so that the left index and zero of the slipping micrometer are alined with the zero of the gunner's aid and right index.

(*e*) Opens the door and, with the azimuth micrometer knob or rotating head, sets the nonslipping azimuth scale at zero (fig. 16).

(*f*) Loosens the slipping azimuth scale locking screw; moves the slipping azimuth scale until its zero coincides with the index on the outside of the door (fig. 17).

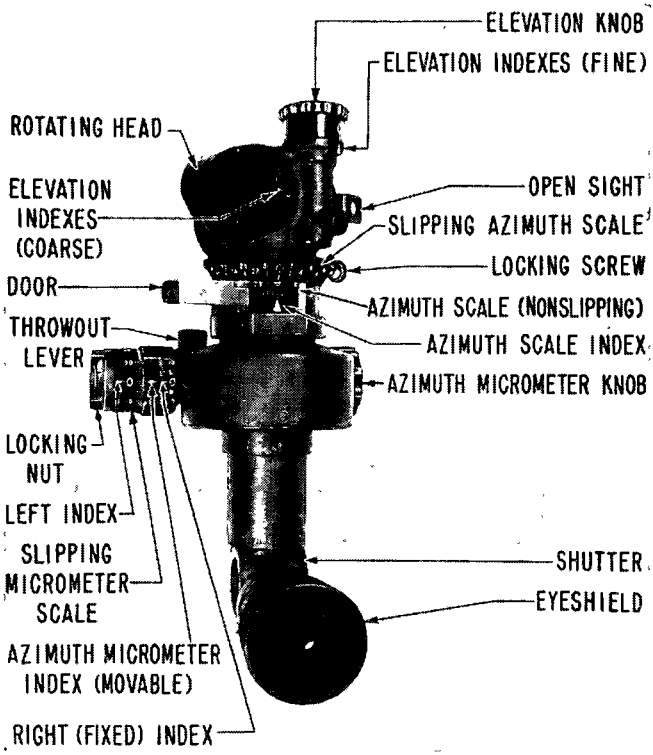

Figure 12. Panoramic telescope M12A7-series.

(*g*) Tightens the locking screw and verifies the reading. With the sight then zeroed, the gunner opens the door and, for indirect fire, sets and reads deflection on the nonslipping azimuth scale, employing the azimuth micrometer for the last two digits of the deflection.

(*h*) The executive commands AIMING POINT THIS INSTRUMENT, NUM-

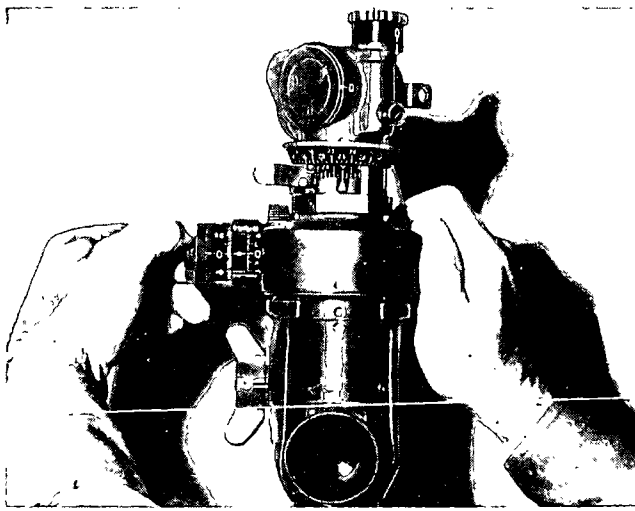

Figure 13. Loosening azimuth micrometer scale locking nut.

BER (so-and-so) DEFLECTION (so much). The gunner sets the deflection for his piece on the panoramic telescope by disengaging the throwout lever and turning the rotating head to the announced hundred mil graduation. He releases the throwout lever and turns off the last two digits of the deflection on the azimuth micrometer scale, using the azimuth micrometer knob. He then traverses the piece until his line of sight through the telescope is on the executive's aiming circle. He checks to insure that the bubbles are level and announces "Number (so-and-so) ready for recheck." As additional deflections are announced by the

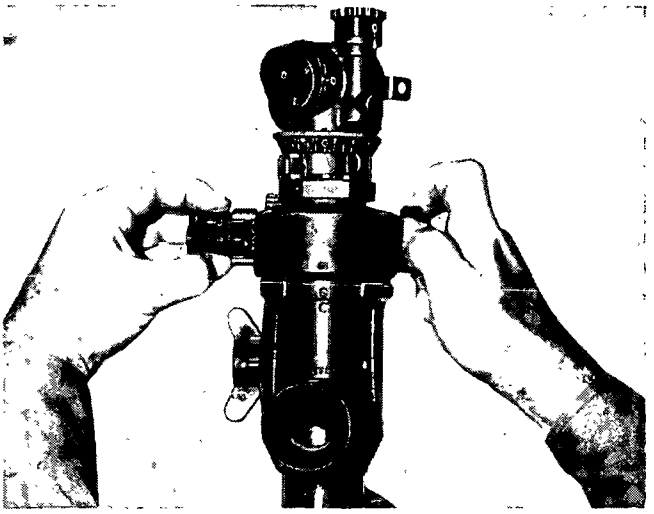

Figure 14. Alining the zero of the slipping micrometer with the left index.

executive, he sets them on the sight and traverses the piece so that his vertical reticle is on the aiming circle. When the executive announces "Number (so-and-so) is laid," the tube is oriented and should not be traversed except on order of the executive.

(3) *Lays the piece for quadrant.*

(*a*) *With the range quadrant on the telescope mount.* With the quadrant set, the gunner turns the elevating handwheel until the longitudinal-level bubble is centered.

(*b*) *With the gunner's quadrant.* For further details, see paragraph 21*b* (1).

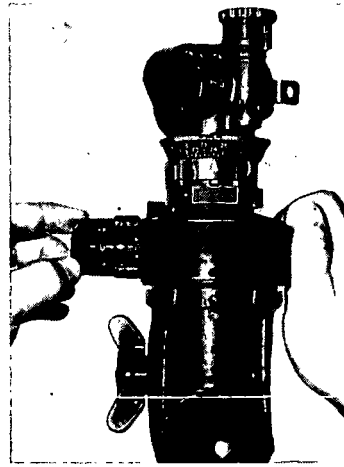

Figure 15. Tightening the locking nut with the slipping azimuth micrometer scale set at zero.

(4) *Alines the aiming posts.* With the piece laid as in (2) above, the executive may command AIMING POINT, AIMING POSTS, DEFLECTION 2400, REFER. At this command, the gunner sets the panoramic telescope at deflection 2400 and, with hand signals, directs No. 5 in alining the posts with the vertical line of the reticle of the sight (fig. 18) (par. 41*c*). If because of the nature of the terrain, the posts cannot be set out at deflection 2400, the gunner turns the azimuth micrometer knob until the nonslipping azimuth scale is on another even hundred mil graduation. He alines the posts at this new deflection. The chief of section reports the altered deflection to the executive "No. (so-and-so) aiming posts

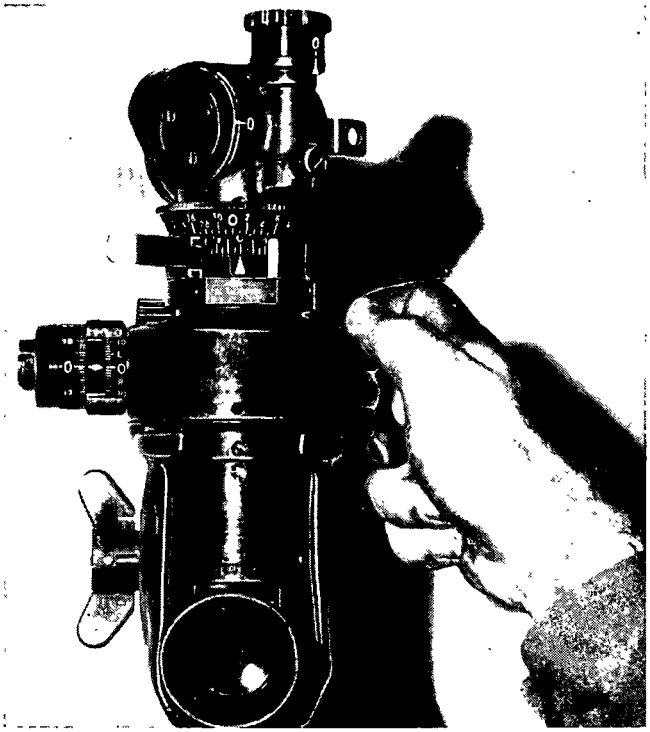

Figure 16. Turning the nonslipping azimuth scale to zero.

at (so many hundred), deflection 2400 in lake (or other reason)." The executive will then command NUMBER (so-and-so), DEFLECTION 2400, REFER. At this command, the gunner loosens the slipping azimuth scale locking screw and moves the slipping azimuth scale to deflection 2400 (fig. 19). He then tightens the locking screw and verifies the adjustment.

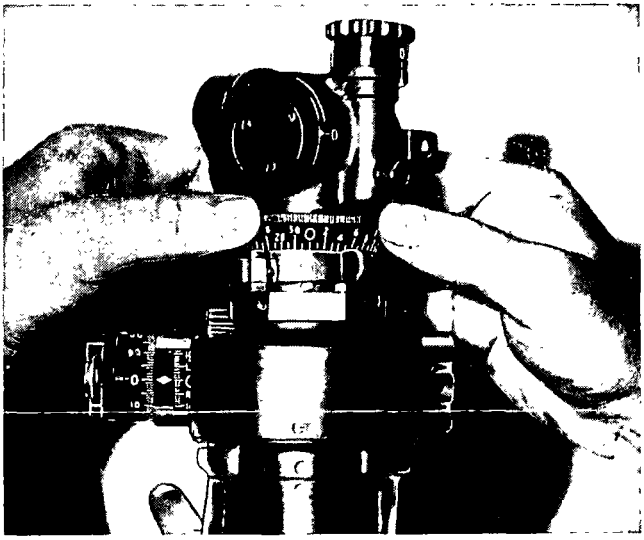

Figure 17. Slipping zero of the slipping azimuth scale to index on door.

(5) *Setting a common deflection on a common aiming point after the piece has been laid.* With the battery having been laid, the executive may command AIMING POINT, CHURCH STEEPLE, LEFT FRONT, REFER. At this command, without moving the tubes, the gunners of all pieces turn their sights to the aiming point designated and report the deflections to the executive. The executive then commands COMMON DEFLECTION 2400. At this command, each gunner loosens the locking screw of the slipping azimuth scale and moves the scale until 2400 is in coincidence with the index

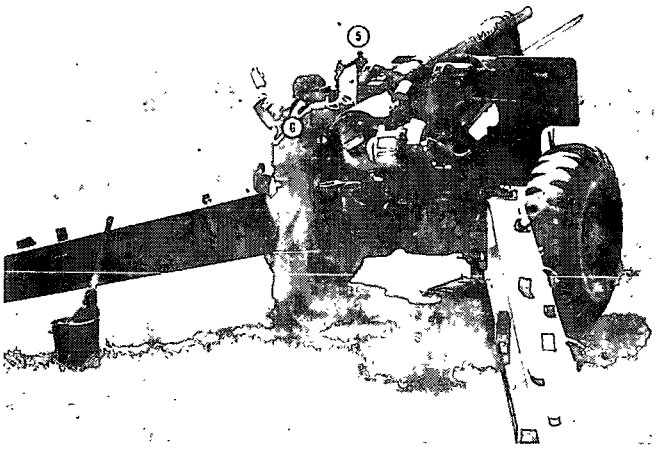

Figure 18. Gunner and No. 5 alining aiming posts.

on the door. Each gunner then unlocks the slipping azimuth micrometer scale locking nut and moves the slipping azimuth micrometer scale to zero, tightens the locking nut, and verifies that zero is in coincidence with the index and that the line of sight is still on the aiming point.

(6) *Setting or changing a deflection.* The command is DEFLECTION (so much). If, for example, the command is DEFLECTION 483, the gunner disengages the throwout lever with his left thumb and turns the rotating head of the sight to 4 (400). He releases the throwout lever, and with his right hand turns off the remaining 83 mils on the micrometer scale (fig. 20).

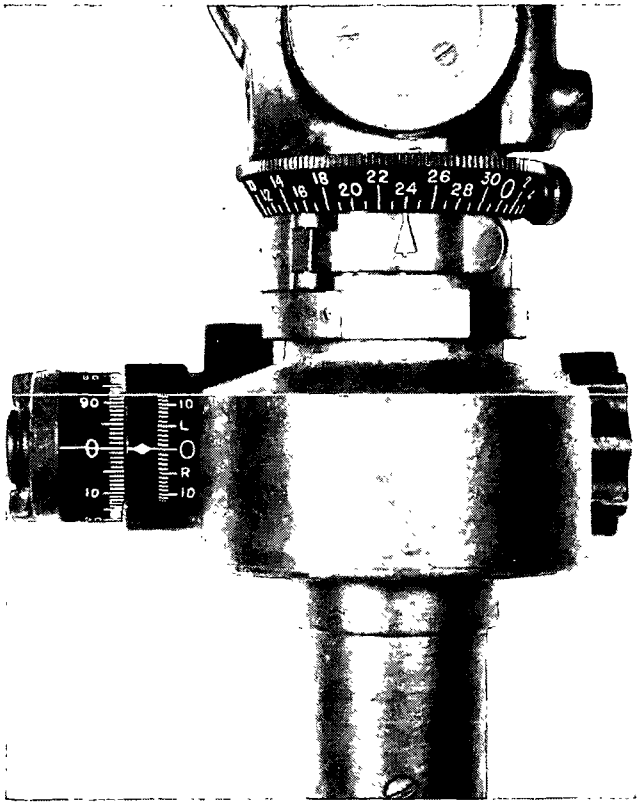

Figure 19. Common deflection 2400.

He then traverses the piece until the vertical line of the reticle is on the aiming post, being careful that the last motion is such as to cause the vertical line of the telescope to approach the aiming point from the left to take up any lost motion in the mechanism.

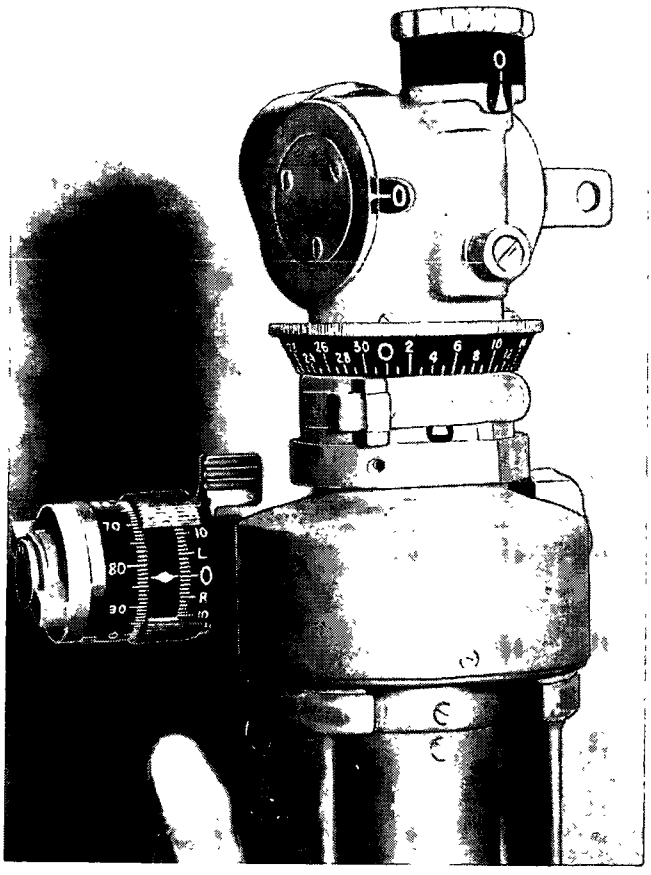

Figure 20. Deflection 483.

(7) *Setting the quadrant.* The gunner is first taught to read quadrants set and later to set announced quadrants. The telescope mount is provided with an elevation scale

graduated in hundreds of mils from 0 to 1,100 mils and a micrometer graduated in mils from 0 to 100. The scale is read opposite the elevation scale index, and the micrometer is read opposite the micrometer index. To set a quadrant of 373, for example, the gunner rotates the elevation knob in the proper direction until the space between 300 and 400 on the scale is opposite the index. He refines the setting by turning the elevation knob until 73 is opposite its index. The last motion should always be in the direction of increasing elevation (fig. 21).

(8) *Referring the piece.* The command from the executive is AIMING POINT THIS INSTRUMENT (or other point), REFER. Without disturbing the laying of the piece the gunner turns only the sight until, with the bubbles level, the vertical line of the reticle is on the point designated. He then reports the deflection to the executive "Number (so-and-so), deflection (so much)."

(9) *Making correction for aiming post displacement.* For details of correcting for aiming post displacement, see paragraph 41.

(10) *Calling "Ready."* After the piece has been laid and number 1 has called "Set," the gunner verifies the laying, moves his head clear of the telescope, and calls "Ready" to indicate that the piece is ready to be fired.

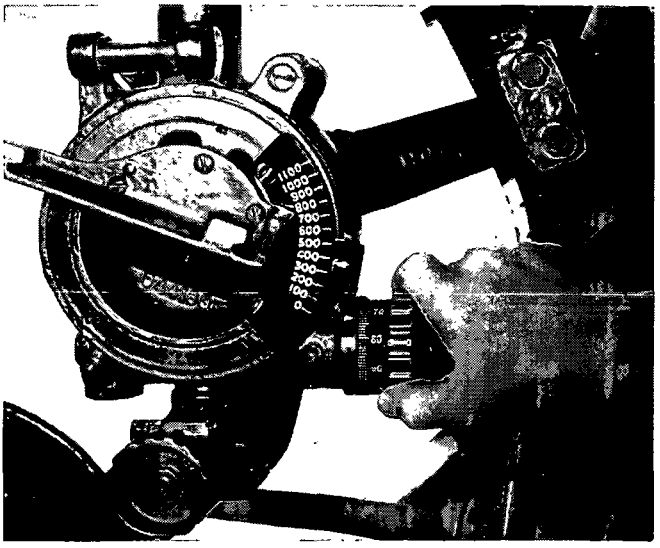

Figure 21. Quadrant 373.

23. Assistant Gunner

The Assistant Gunner.

a. AG—

(1) Primes the piece.
(2) Opens and closes the breech.
(3) Attaches and detaches the lanyard.
(4) Cleans and oils the breechblock and the breech recess.
(5) Cleans the primer vent and the primer seat.
(6) Cleans and oils the firing mechanism M1.
(7) Calls "Set."
(8) Fires the piece.

b. Detailed Description of Duties.

(1) *Primes the piece.* Immediately after the piece returns to battery after a round is

fired, AG disengages the firing mechanism safety latch and unscrews the firing mechanism by turning it a one-quarter turn counterclockwise. He then opens the breech; after the breech is open, the firing mechanism is completely removed and held with the notch in the primer holder facing up. He then slides the base of the primer out of the holder. In seating a new primer in the primer holder, he holds the firing mechanism in the same manner, taking the precaution to keep his right hand clear of the front end of the primer while he slides the primer into the holder (fig. 22). After the projectile and propelling charge for the next round have been loaded, AG closes the breech. He places his left hand on the percussion hammer and with his right hand inserts the firing mechanism in the housing, taking care that the front end of the primer has entered the obturator spindle plug. He seats the firing mechanism by turning

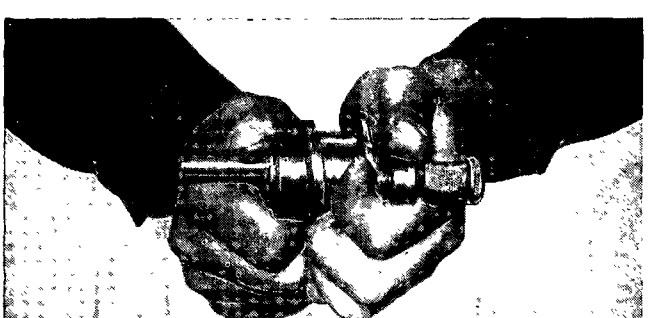

Figure 22. Inserting primer in firing mechanism.

the handle clockwise until it contacts the firing mechanism block handle arm stop and is latched (fig. 23). If the firing mechanism is not properly seated and latched, materiel may be damaged and personnel injured. Should a primer be slightly oversized or the primer seat dirty, the mechanism will stick before it has been fully seated. Force should not be exerted to seat the firing mechanism; it should be removed and the primer seat cleaned or another primer inserted. Unfired primers to be discarded are turned over to the chief of section for disposal.

(2) *Opening and closing the breech.*

(*a*) *To open the breech.* After disengaging

Figure 23. Seating the firing mechanism.

the firing mechanism, AG slides the breech operating lever closing latch to the left, pulls the operating lever rearward and downward to the horizontal position, and swings the lever to the right until the breech is fully open. He removes and primes the firing mechanism and then detaches the lanyard.

(*b*) *To close the breech.* After No. 3 has called "Close," AG grasps the breech operating lever and swings it to the rear and to the left until the breech is fully closed and then upward until it is engaged by the breech operating lever closing latch. After he has seated the firing mechanism and the gunner has called "Ready," AG reaches beneath the breech and attaches the lanyard with his right hand. *AG will not attach the lanyard until the gunner has called "Ready."* The chief of section may caution, "With the long lanyard," in which case AG attaches the long lanyard.

(3) *Cleaning and oiling the breechblock and the breech recess.* Whenever possible and during lulls in firing, AG will wash the powder residue from the mushroom head, the gas check seat, and the threaded sectors of the breech recess and breechblock with a water-saturated cloth and then oil the parts with a cloth *slightly dampened* with oil, lubricating, preservative, medium (for temperatures of 32° F. and above) or with oil, lubricating, preservative, special (for tem-

peratures below 32° F.). When necessary, he will oil the operating parts of the breech mechanism with the same oil as specified for the breech recess and breechblock.

(4) *Cleaning the primer vent and primer seat.* Upon completion of the duty prescribed in (3) above, AG cleans the primer vent with the vent cleaning tool and removes residue from the primer seat with the primer-seat cleaning reamer.

(5) *Cleaning and oiling the firing mechanism.* Two firing mechanisms M1 are provided for each howitzer. They should be used alternately. As soon as one mechanism is inserted in the breechblock, AG will clean and oil the other and insert a new primer for use with the next round. During lulls in firing both mechanisms must be cleaned and oiled thoroughly.

(6) *Calling "Set."* AG calls "Set" when the piece has been loaded, the breech closed, and the firing mechanism fully seated.

(7) *Fires the piece.* After the gunner has called "Ready," AG attaches the lanyard with his right hand while holding the percussion hammer with his left hand. At the chief of section's signal or command FIRE, AG pulls strongly with a quick movement to the right rear, prolonged sufficiently to insure that the hammer hits the firing pin. After firing, he releases the lanyard. In case of a misfire, the instructions in paragraph 82 will be followed.

24. Number 1

a. Number 1—

(1) Swabs and inspects the powder chamber after each round.

(2) Rams the projectile, assisted by No. 4.

(3) In volley fire, calls out the number of the round and the announced quadrant.

(4) Swabs out the bore, assisted by No. 3.

b. Detailed Description of Duties.

(1) *Swabs and inspects the powder chamber after each round.* After each round, No. 1 sponges out the powder chamber immediately after AG opens the breech. The rear of the bore, including the forcing cone, is swabbed with a sponge dipped in water. Before the piece is loaded, and after swabbing between rounds, No. 1 inspects the bore for damage to the tube, for burning fragments of powder bags, or for other objects. Any burning fragments or other objects in the bore must be removed before reloading. He calls out "Bore clear" if it is clear. Any damage to the piece will be reported to the chief of section.

(2) *Ramming the projectile.* As soon as the lip of the loading tray is placed in the breech recess, No. 1 procures the rammer staff and, working on the left, places the rammer head against the base of the projectile. Assisted by No. 4 on the right, No. 1 pushes the projectile into the breech recess until the base of the projectile clears the rear of the powder chamber (fig. 24).

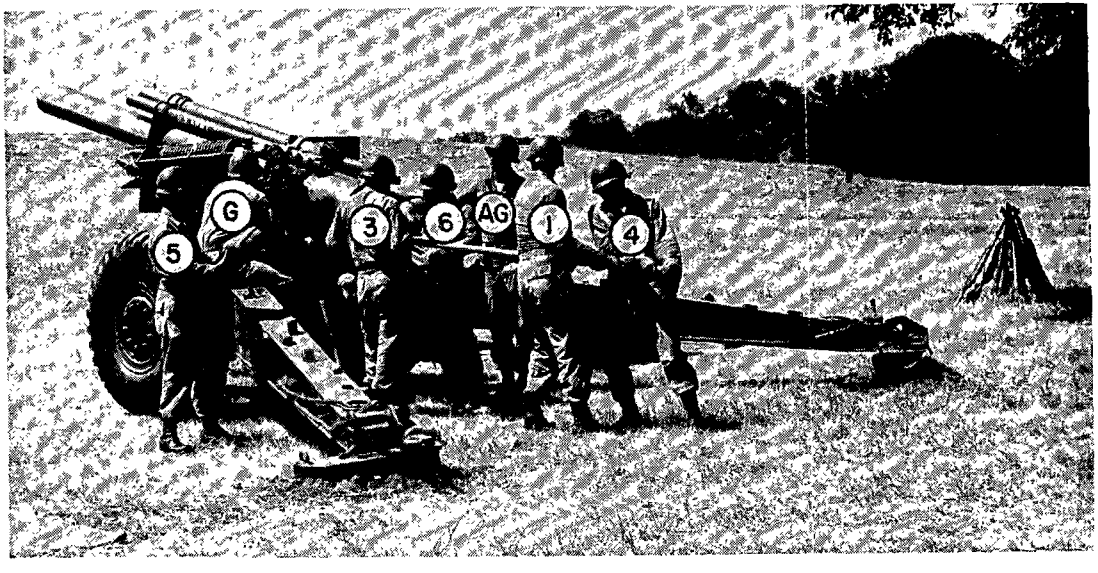

Figure 24. Placing projectile in chamber.

No. 1 then commands READY, RAM. At RAM, Nos. 1 and 4 drive the projectile forward into the forcing cone, using their arms and weight to add power to the stroke (fig. 25). Uniform ramming is essential to standardize interior ballistic effects and to reduce the possibility of getting varying ranges at the same scale settings. Uniformity is attained by ramming as hard as possible. Firm seating of the projectile is necessary to prevent it from slipping back into the powder chamber and resting on the charge, especially at high elevations. After the projectile is rammed, No. 1 returns the rammer staff to its position near the left trail.

(3) *In volley fire, calls out the number of the round and the announced quadrant.* In volley fire, to insure firing the correct number of rounds, No. 1 calls out the number of the round and the quadrant as he finishes ramming the projectile. As he finishes ramming the last round, he adds, "Last round." For example, when two rounds are to be fired at quadrant 480, he calls out, "Second and last round, 480." He should not speak louder than is necessary to insure being heard by the members of his own section.

(4) *Swabbing out the bore.* The chief of section directs the swabbing of the bore during lulls in firing or at other times. The piece is brought to the horizontal by the

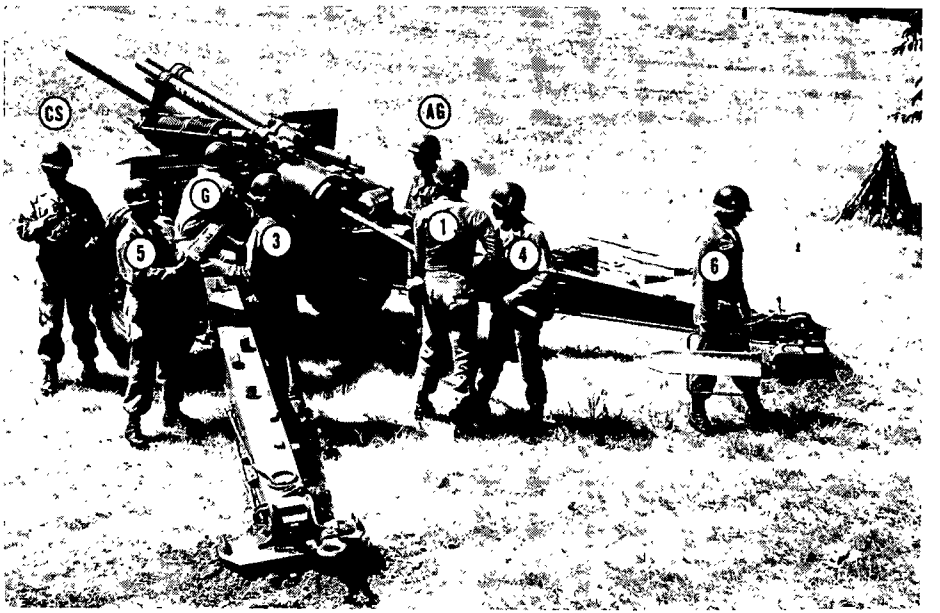

Figure 25. Ramming the projectile.

gunner. No. 1, assisted by No. 3, swabs the bore as prescribed in TM 9–331A.

25. Number 2

a. Number 2—

(1) Fuzes or changes fuzes of projectiles.

(2) Sets the fuze setter.

(3) Sets fuzes.

(4) Removes fuzes from projectiles.

b. Detailed Description of Duties.

(1) *Fuzes or changes fuzes of projectiles.* No. 2 unscrews the eyebolt lifting plug from the fuze socket of the projectile, inspects the socket for rust and dirt, removes (or replaces) the supplemental charge if necessary, and screws in the designated fuze (TM 9–331A). In tightening or loosening the fuze of a projectile, only the authorized fuze wrench should be used. Variable time (VT) fuzes should be screwed in by hand and tightened with fuze wrench M18, using only manual force. *Do not hammer on the wrench or use an extension handle.* If a time fuze is used, No. 2 removes the safety pull wire from the fuze and, if a booster is present, the safety pin from the booster. Boosters without safety pins must not be used.

(2) *Setting the fuze setter.*

(*a*) *Fuze setter M26.* The fuze setter M26 (fig. 26) has two time scales (0 to 25 seconds and 0 to 75 seconds) and one clamping screw which clamps both

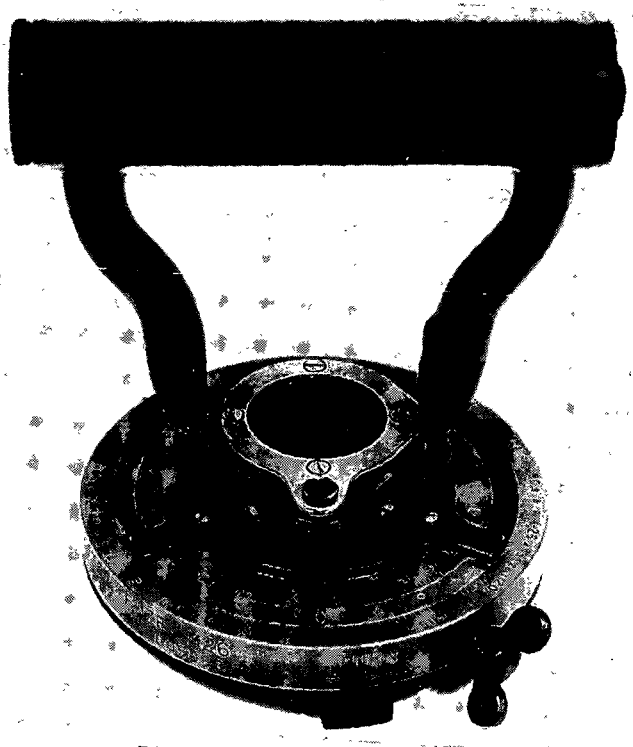

Figure 26. Fuze setter M26.

scales. The scale set depends on the fuze series involved. No. 2 releases the time scale clamping screw marked "T," and, holding the fuze setter by the outer ring, turns the inner body with the handle until the index on the body is opposite the announced time on the time scale. He then locks the time scale clamping screw, being careful not to disturb the

setting. For accuracy, No. 2 looks squarely at the scales and indexes from the same angle each time.

(*b*) *Fuze setter M28.* The M28 fuze setter has two time scales. The inner ring or scale can be set from 0 to 45 seconds; the outer ring or scale, from 0 to 100 seconds. To set the M28 fuze setter, No. 2 releases the clamping screw and places the fuze setter on the fuze. He then sets the desired time setting by turning the inner and outer rings on the fuze setter. He then locks the clamping screw, being careful not to disturb the setting.

(3) *Setting fuzes.*

(*a*) *Selective superquick and delay fuzes.* When the command FUZE QUICK is announced, No. 2 verifies the superquick setting. (The slot on the setting sleeve should be alined with the letters "SQ.") When the command FUZE DELAY is announced, he turns the setting sleeve until the slot is alined with the word "DELAY."

(*b*) *Combination time and superquick fuzes.* Combination time and superquick fuzes may be set for time action. However, the percussion element will detonate the round upon impact if the time element fails. After fuzing the projectile, No. 2 removes the safety pull wire from the fuze. For percussion action, the command is FUZE M520 QUICK (or other designation). For time fuzes, No. 2 veri-

fies that the "S" on the setting ring is alined with the index on the fixed ring. If not, he sets at "S."

(*c*) *VT fuze.* The VT fuze can be set for either time or superquick. Time settings of 0 to 100 seconds can be set on this fuze by using the M28 fuze setter.

(*d*) *Fuze setter M26.* Fuze setter M26 may be used with TSQM54, TSQM55, MT67, TSQM500, TSQM501, and TSMQ520. No. 2 releases the time scale clamping screw marked "T," and, holding the fuze setter by the outer ring, turns the inner body with the handle until the index of the body is opposite the announced time on the time scale. He locks the time scale clamping screw, being careful not to disturb the setting. He seats the fuze setter on the fuze by inserting the upper lug of the setter in the upper recess of the fuze. He moves the handle of the setter to the horizontal position and turns the setter (in the direction of increasing reading) until he feels it stop and hears a click. He then raises the handle to the vertical position, removes setter, and verifies the setting visually. As an alternate method, No. 2 may seat the fuze setter on the fuze before setting the announced time on the setter. He then must loosen the wingnut and move the outer ring until the announced time is opposite the index, lock the wingnut, place the handle in the hori-

zontal position, and set the fuze as indicated above (fig. 27).

Note. This method should be used with care to insure that the fuze is not unscrewed from the projectile while the setter is being adjusted to the announced time.

(*e*) *Fuze setter M27.* Fuze setter M27 is a wrench-type fuze setter in which the fuze time scale is used in setting the fuze. With M500 fuzes, No. 2 engages the key of this fuze setter in the notch on the setting ring of the fuze and rotates the setting ring counterclockwise (increasing direction) until the announced time set-

Figure 27. Setting time fuze.

ting of the fuze time scale is opposite the index mark on the fuze. With M54 and M55 fuzes, the setting ring is rotated in a counterclockwise direction.

(*f*) *Fuze setter M28.* Fuze setter M28 (only) should be used to set fuze VT M514-series. No. 2 places the stationary lug on the setter into the top recess of the fuze and pushes down until the setter is fully seated on the fuze. He sets the fuze by placing the announced setting on the fuze setter and turning clockwise until the setter stops or he hears a click. He then removes the setter and makes a visual check of the fuze for proper setting.

(4) *Removing fuzes from projectiles.* If for any reason a projectile that has been fuzed is not fired, the fuze is removed. To remove the fuze, the reverse procedure for inserting a fuze is followed. Supplemental charges issued with the projectile will be replaced. The booster cotter pin of the fuze is replaced, if provided with the fuze. Combination superquick and delay fuzes are reset to superquick. Time fuzes are reset to S (safe) and the safety pull wire is replaced. All fuzes are returned to their containers. The eyebolt lifting plugs are replaced in the fuze sockets of the projectiles.

26. Number 3

a. Number 3—

(1) Assist No. 6 in carrying projectiles to the piece.

(2) Places the powder charge in the chamber.
(3) Calls "Close."
(4) Assists No. 1 in swabbing the bore.
(5) Assists in preparing ammunition for firing.

b. Detailed Description of Duties.

(1) *Assists No. 6 in carrying projectiles to the piece.* After No. 6 places the fuzed projectile on the loading tray, No. 3 grasps the handles on the left side and together they carry the tray to the piece. They place the lip of the tray in the breech recess against the rear face of the tube and hold it there until Nos. 1 and 4 push the projectile into the chamber with the rammer. No. 3 then releases the handles and the tray is withdrawn by No. 6.

(2) *Placing the powder charge in chamber.* After releasing the tray, No. 3 turns and receives the powder charge from No. 5. He places the powder charge in the powder chamber, lashed end to the front (fig. 28), and pushes it in until the base of the charge is approximately 3 inches inside the chamber (fig. 29). By placing it in this position, it is possible to avoid unduly large gaps between the obturator spindle and the powder bag when the breechblock is closed. No. 3 must insure that the red igniter pad is to the rear and that the igniter protector cap has been removed. As an added safety precaution, when temperature of the obturator permits, No. 3 will place his left hand against the obturator while loading as shown in figure 28.

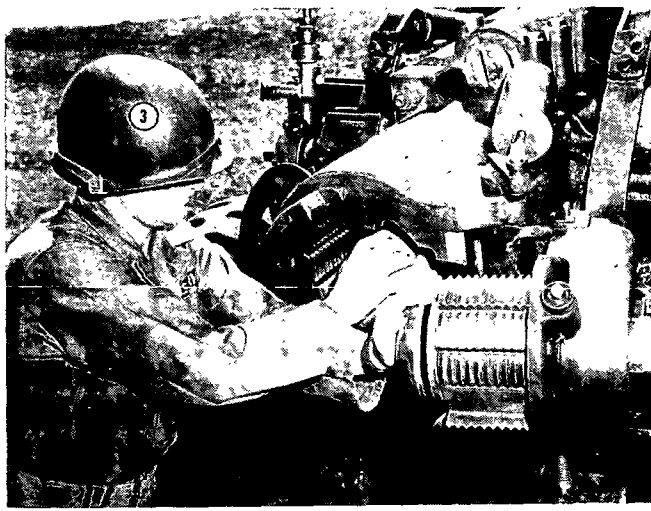

Figure 28. Placing powder charge in chamber.

(3) *Calls "Close."* After placing the powder charge in the chamber and removing his hand from the breech recess, No. 3 calls "Close" to notify AG that it is safe to close the breech.

(4) *Assists No. 1 in swabbing out the bore.* For additional information, see paragraph 24*b*(4) and TM 9–331A.

(5) *Assists in preparing ammunition for firing.* (For additional information, see pars. 28 and 29.)

27. Number 4

a. Number 4—

(1) Assists No. 1 in ramming the projectile (fig. 25).

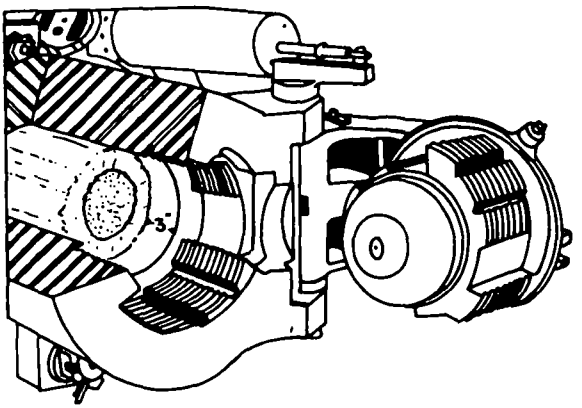

Figure 29. Powder charge in chamber.

(2) Performs other duties as directed by the chief of section.

(3) Assists No. 2 in preparing ammunition.

b. Detailed Description of Duties.

(1) *Assists No. 1 in ramming the projectile.* For a detailed description, see paragraph 24*b*(2).

(2) *Performs other duties as directed by the chief of section.* No. 4, when not otherwise occupied, may assist in preparation and cleaning of projectiles, in preparation of powder charges, or as otherwise directed by the chief of section.

(3) *Assists No. 2 in preparing ammunition.* For a detailed description, see paragraph 25*b*.

28. Number 5

a. Number 5—

(1) Prepares powder charges.

(2) Passes powder charge to No. 3.
(3) Calls out the number of the charge.
(4) Sets out aiming posts when so directed.

b. Detailed Description of Duties.

(1) *Prepares powder charges.*

(*a*) *Type M3 (green bag).* The M3 (green bag) propelling charge is a multiple-section charge of smokeless powder with the necessary black powder igniter; it consists of a base charge and four smaller increments corresponding to five zones of fire. The charge is marked "charge 1," and the other bags are numbered from 2 to 5, inclusive. When the command designating the charge to be used is given, for example, CHARGE 3, No. 6 takes a complete charge from one of the containers, places the complete charge in front of him with the base charge on the bottom, and unties the lashings which hold the bags together. Without disturbing the order in which they are arranged, he checks the increments and removes the bags marked "4" and "5", leaving the bag marked "3" at the top of the pile. He then ties the remaining bags (charges 1, 2, and 3) together, removes the igniter protector cap on the base of the charge, and passes the charge thus prepared to No. 3. The discarded bags (charges 4 and 5) are given to the chief of section. After the round is fired, the discarded bags are placed in the powder pit provided for that purpose,

for disposal later as the chief of section may direct. No flash reducer is necessary for use with this charge (TM 9–1300–205).

(*b*) *Type M4 (white bag).* The M4 powder charge consists of a base charge (charge 5) and two increments corresponding to charges 6 and 7, respectively. Preparation of this charge is accomplished as in (*a*) above, except that no charge lower than charge 5 can be prepared. *Green and white bag increments must not be mixed in the same charge.* In night firing, when the flash reducer M2 (T2) is used, No. 5 assembles the propelling charge and flash reducer by tying one flash reducer at the forward end of the base charge and one at the forward end of each increment used (TM 9–1300–203).

(*c*) *Type M4A1 (white bag).* Type M4A1 (white bag) is composed of a base charge (charge 3), with igniter, and four increments corresponding to charges 4, 5, 6, and 7, respectively. The preparation of a charge with this type is similar to that described in (*a*) above, except that no charge lower than charge 3 can be prepared. *Under no circumstances will green and white bag increments be mixed in the same charge.* The propelling charge and flash reducer is assembled as in (*b*) above.

(2) *Passing powder charge to No. 3.* As the projectile is being seated in the breech and

after the powder charge has been prepared as in (1) above, No. 5 passes charge to No. 3.

(3) *Calling out the number of the charge.* After passing the powder charge to No. 3, No. 5 calls out the number of the charge he has prepared. This informs the chief of section that the proper charge has been prepared.

(4) *Sets out aiming posts when so directed.* For a detailed description, see paragraph 22*b*(4).

29. Number 6

a. Duty. Number 6 carries projectiles to the piece, assisted by No. 3.

b. Detailed Description of Duty. No. 6 obtains the fuzed projectile and places it on the loading tray. Nos. 6 and 3 then grasp the right and left handles on the tray and together carry the tray and projectile to the piece (fig. 24). They place the lip of the tray in the breech recess against the rear face of the tube and hold it there until Nos. 1 and 4 push the projectile into the chamber with the rammer. No. 3 then releases the handles and No. 6 returns the tray to the place where the ammunition is being prepared.

30. Number 7

a. Duty.

(1) Inspects and cleans projectiles.

(2) Holds projectile upright while it is being fuzed and the fuze is being set.

b. Detailed Description of Duty.

(1) *To inspect and clean projectile.* Number 7

verifies type, weight, and lot numbers (when appropriate) of each projectile, removes the grommet, and examines the projectile carefully for defects. He inspects each round to see that it is free from sand and dirt and that the rotating band is not burred. The projectile is then placed upright on its base and the entire surface cleaned. Projectiles with burred rotating bands are put aside until No. 7 can remove the burs with a file. If any appreciable length of time intervenes between the cleaning of the projectile and its insertion into the piece, the projectile must be reinspected. Any sand or dirt on the projectile will cause undue wear, scratches or gouges in the bore of the weapon.

(2) *To hold projectile upright while it is being fuzed and the fuze is being set.* After the command is given that designates the projectile to be used, for example, SHELL HE, No. 7 holds the projectile upright while No. 2 fuzes it and sets the fuze. When so directed by the chief of section, No. 7 will read and announce the time as set.

Section II. DIRECT LAYING, GENERAL

31. General

a. Firing by direct laying is a special technique that demands a high standard of training. The section must operate as an independent unit. Training in direct laying is based on the technique in-

volved in indirect laying. Targets taken under fire by the section in direct laying are usually those capable of returning fire on the howitzer section at pointblank range, therefore, the speed and accuracy required in indirect laying become even more important for direct laying missions.

b. For additional information on direct laying, see FM 6–40.

32. Preparation of a Range Card

a. The chief of section is responsible for defense of his assigned sector, but he should be prepared to fire on targets in other sectors.

b. As soon as possible after occupation of position, the chief of section measures or estimates the ranges to critical points in likely avenues of approach for enemy tanks and vehicles and prepares a range card (fig. 30) upon which he notes the ranges for quick reference.

c. If there are no prominent terrain features, stakes may be driven into the ground at critical points for reference. As time permits, the range card is improved by replacing estimated ranges with more accurate data obtained by firing, pacing, taping, vehicle speedometer reading, map measurement, or survey.

33. Field of Fire

The sector of fire for the piece should, if possible, be cleared of all obstructions that might endanger battery personnel when the piece is fired or that might hinder observation. Care should be taken not to give away the location of the position.

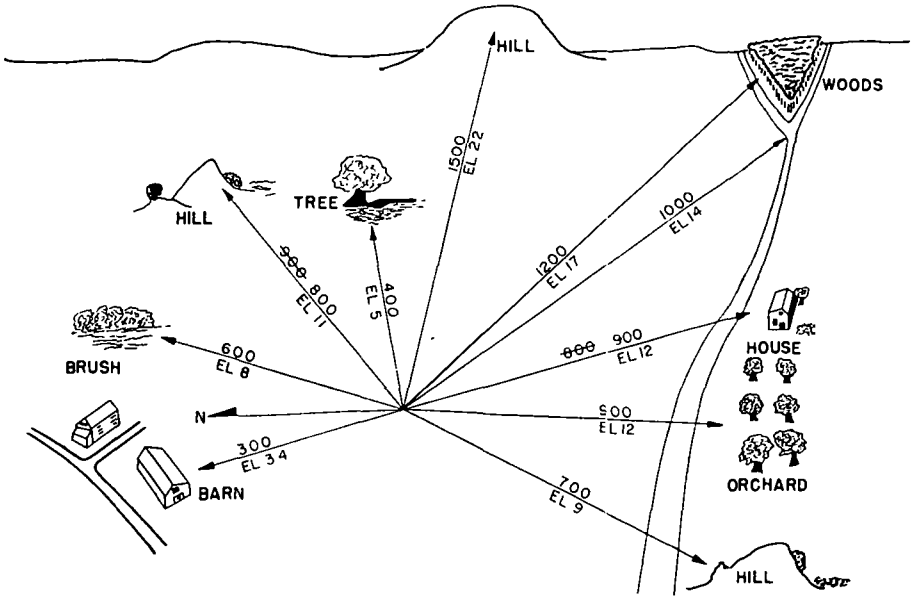

Figure 30. Range card for direct laying.

34. Conduct of Fire

a. Trajectories. Trajectory characteristics change with the type of ammunition and the charge fired. The following trajectory characteristics govern the conduct of fire when charge 7 is used:

(1) *Ranges from 0 to 400 meters.* Within these range limits, the trajectory will be flat enough to prevent an 8-foot tank from passing safely under it. Fields of fire and terrain allowing, the upper range limit for the ammunition and charge used is the ideal at which to open fire. Fire can then be conducted over the maximum time without misses if deflection is correct. There is also less risk of obscuring the target with the smoke from a short burst.

(2) *Ranges from 400 to 1,500 meters.* These range limits include the zone in which the trajectory is sufficiently flat to permit direct estimation of range without actually bracketing the target. Assuming little dispersion, if a hit is obtained at the bottom of an 8-foot tank when firing at the upper range limit (1,500 meters), a 100-meter increase in range will result in a round which will just brush the top of the tank. During adjustment within this zone, range changes should seldom be more than 100 meters, and frequently range changes of 50 meters will be sufficient. The upper limits mentioned herein are the greatest ranges at which fire should be opened unless tactical conditions require otherwise. A trained

howitzer crew should obtain hits by the second shot.

(3) *Ranges from 1,500 to 2,500 meters.* This zone includes the ranges at which hits are only reasonably possible, and bracket methods are normally used to obtain adjustments. Fire should not be opened at these ranges unless surprise is not important.

(4) *Ranges over 2,500 meters.* At ranges over 2,500 meters when charge 7 is used, direct laying is not advisable against moving targets. Ranges must be known accurately or determined by bracketing. At these ranges, the slope of fall of the projectile becomes so great that a hit on a moving target is very difficult to obtain.

(5) *Elevation changes.* For ranges up to 1,500 meters, an elevation change of 1.5 mils changes the range approximately100 meters. A 1-mil change in elevation raises or lowers the path of the projectile (trajectory) as follows: 1.5 feet at 500 meters range, 3.0 feet at 900 meters range, and 4.5 feet at 1,400 meters range.

b. Vertical Displacement Table. Vertical displacement is the change in the point of burst (up or down) between two rounds fired at upright target at different range settings. Table IV shows the vertical displacement for a 100-yard (meters) range change at various ranges, firing shell HE, charge 7.

c. Types and Selection of Targets for Direct Laying. Targets for direct laying usually consist of vehicles, tanks, and personnel threatening the battery. Enemy personnel, whether alone or accom-

Table IV. Vertical Displacement (Feet) Per 100-Yard or 100-Meter Range Change

Elev	Range (meters)	Vertical displacement (feet), shell HE charge 7	Remarks	Range (meters)	Elev
1.6	100	0.5	Start firing using a 400-yard	100	1.6
3.2	200	1.0	(meter) range setting.	200	3.2
4.8	300	1.5		300	4.8
6.4	400	1.5	Start firing with estimated	400	6.4
8.1	500	2.0	range. Increase or decrease	500	8.1
8.1	500	2.5	by multiple of 50 or 100	500	8.1
9.8	600	3.0	meters. Bracketing not	600	9.8
11.5	700	3.5	necessary.	700	11.5
13.2	800	4.0		800	13.2
14.9	900	4.5		900	14.9
16.7	1,000	5.0		1,000	16.7
18.5	1,100	5.5		1,100	18.5
20.3	1,200	6.0		1,200	20.3
22.1	1,300	6.5		1,300	22.1
23.9	1,400	7.0		1,400	23.9
25.8	1,500	8.0	Bracket target (get bursts over	1,500	25.8
27.7	1,600	8.5	and short) to obtain hit.	1,600	27.7
27.7	1,600	9.0		1,600	27.7
29.6	1,700	9.5		1,700	29.6
31.5	1,800	10.5		1,800	31.5
33.5	1,900	11.0		1,900	33.5
35.5	2,000	12.0		2,000	35.5
37.5	2,100	12.5		2,100	37.5
39.6	2,200	13.0		2,200	39.6
41.6	2,300	13.5	At ranges over 2,500 yards (meters) using shell HE, charge 7, direct firing is too inaccurate to be used against moving targets.	2,300	41.6

panying tanks, will seldom present themselves as a clearly defined target. Normally, attacking troops, using all available cover, reveal themselves only fleetingly. Accordingly, fire is conducted on the area containing the attackers rather than upon

the individuals. Tanks usually attack in groups and may be accompanied by infantry. Normally, first priority is given to attack of those targets within the assigned sector of the weapon and second priority to targets in other sectors. Priority within the assigned sector is given to—

(1) Tanks at short ranges, threatening to overrun the position.
(2) Hull down stationary tanks, covering the advance of other tanks.
(3) The commander's tank, if identified.
(4) Tank nearest to cover.
(5) The rear tank of a column moving across the front of the position (to avoid disclosing position to leading tanks).

d. Ammunition and Fuzes.

(1) *General.* For close-in fires, a variety of fuzes and shells is available. When high explosive shell is used, charge 7 is used habitually for speed, ease in adjustment, imparting forward motion to fragments, and more effective fuze action. The flat trajectory resulting from use of charge 7 coupled with dug-in pieces may make extremely close-in fire difficult due to the ricocheting of projectiles. At ranges of 200 to 400 yards (meters) fuzes may fail to function on hard, flat ground; however, preparation of sectors of fire can improve this situation. The terrain may be prepared for direct fire by placing mounds of sandbags, dirt, or logs in the howitzer's sector of responsibility. When direct fire is placed on these or other previously se-

lected points, as they are approached by an attacking force, the necessity for adjusting fire is reduced.

(2) *Ammunition.* Ammunition may be high explosive (HE), nonirritant smoke (FS), or white phosphorus (WP), depending on availability. Shell HE is ideally suited for antipersonnel fire and is effective against vehicles and tanks. Shell WP may be used to set immobile tanks and vehicles on fire, to further restrict defiles, and to produce casualties. Shell FS may be used when a relatively harmless smokescreen is desired. However, consideration must be given to the effect of the resulting smokescreen on the defending forces.

(3) *Fuzes.* WP ammunition is fuzed with a superquick-delay fuze while HE may be used with fuzes quick, delay, or time.

(*a*) Fuze quick is the most desirable fuze to use with HE shell on close-in fires. It is highly effective and, since no fuze setting is required, is much faster to use.

(*b*) The time required to set the fuze and to adjust the point of impact for maximum ricochet effect makes fuze delay less desirable than fuze quick. When fuze delay is used to gain ricochet effect, the point of impact is adjusted 10 to 30 yards (meters) in front of the target. If less than 50 percent of the bursts are ricocheted, the fuze should be changed to quick.

(*c*) Fuze time is the least desirable fuze for

close-in fires. Due to the wide range dispersion resulting from variations in time of burning with short fuze settings, this fuze should be used only for ranges of more than 1,000 yards (meters). The areas covered effectively by air and ricochet bursts are similar.

Section III. DIRECT LAYING DUTIES

35. Chief of Section

a. Duties. The chief of section—

(1) Conducts the fire of his piece.
(2) Identifies or selects the target.
(3) Estimates the range to the target.
(4) Determines the lead in mils.
(5) Gives initial commands.
(6) Gives subsequent commands, based on observed effect.

b. Detailed Description of Duties.

(1) *To conduct the fire of his piece.* The chief of section conducts the fire of his piece when the executive commands TARGET (so-and-so), FIRE AT WILL, or simply FIRE AT WILL.

(2) *Identifying or selecting the target.* The chief of section designates an object or one of a group of objects as the target, the chief of section must correctly identify this target. If the target is a group of tanks or other objects, the chief of section selects the target that, in his estimation, is the greatest threat to his own position or the position of the supported troops.

(3) *Estimating the range to the target.* Range cards (fig. 32) with accurately measured ranges and corresponding quadrants to key points provide the best means for determining the initial range. If a range card has not been prepared, the range is estimated.

(4) *Determining the lead in mils.* The appropriate lead in mils is determined by the speed of the target, range, course at which it is moving, and charge being fired. With shell HE charge 7, approximate initial leads are slow (0–5 mph), 5 mils; medium (5–10 mph), 10 mils; fast (10–15 mph), 15 mils. Based upon the observed effect, the lead is changed as necesary.

(5) *Giving initial commands.* The chief of section gives fire commands containing the following elements in sequence:

(*a*) *Designation of target.* The command is TARGET (so-and-so).

(*b*) *Projectile, charge, and fuze.* The chief of section commands the appropriate items in sequence such as SHELL HE, CHARGE 7, FUZE QUICK. He selects the charge, fuze, and projectile in accordance with considerations contained in paragraph 33*d*. The M78A1 concrete-piercing fuze should be used against concrete pill boxes or fortification.

(*c*) *Lead.* The command is LEAD (so much). See (4) above for method of determining lead.

(*d*) *Method of fire.* Fire is continuous unless otherwise commanded. In continuous fire, the piece is loaded and laid as rapidly as possible and fired at the command of the gunner.

(*e*) *Quadrant.* The command is QUADRANT (so much). See (3) above.

(6) *Gives subsequent commands, based on observed effect.*

(*a*) *Change in lead.* During adjustment the lead is changed by the command RIGHT (LEFT) (so much).

(*b*) *Change in quadrant.* During adjustment the quadrant is increased by the command ADD (so much) and decreased by the command DROP (so much). See paragraph 33 for the method of determining changes in quadrant during adjustment of fire.

36. Gunner

a. Duties. The gunner—

(1) Centers the cross-level bubble on the panoramic telescope mount initially.

(2) Sets the elevation indexes and the azimuth scales of the panoramic telescope at zero.

(3) Lays on the target with the announced lead.

(4) Tracks the target with the traversing handwheel.

(5) Operates the elevating handwheel to keep the horizontal line in the reticle on the target.

(6) Commands FIRE.

(7) Re-lays on the target.

(8) Follows subsequent commands.

b. Detailed Description of Certain Duties.

(1) *Lays on the target with the announced lead and track the target.*

(*a*) Prior to any direct fire mission, the gunner verifies that the movable azimuth micrometer (gunner's aid) index is set at zero.

(*b*) If the slipping azimuth and slipping micrometer scales have not been slipped, the gunner zeros these two scales.

(*c*) If only the slipping azimuth scale has been slipped, the gunner disregards this scale. He opens the door over the nonslipping azimuth scale and sets that scale at zero. The micrometer scale is brought to zero.

(*d*) If both the slipping micrometer scale and the slipping azimuth scale have been slipped, the gunner opens the azimuth scale door and turns the nonslipping azimuth scale to zero. He then turns the azimuth micrometer knob until the left index of the micrometer matches the right index.

(*e*) The operations described in (*a*), (*b*), (*c*), and (*d*) above make the line of sight of the telescope parallel to the axis of the bore. The gunner then tracks the target using the traversing and elevating handwheels, keeping the vertical line of the panoramic telescope ahead of the target by measuring the announced lead on the reticle scale and keeping the horizontal

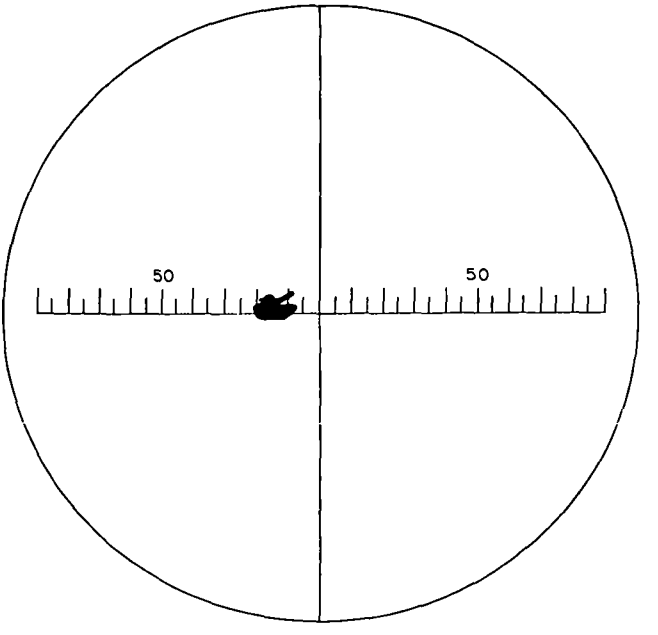

Figure 31. Gunner's sight picture (lead 15 mils).

line of the reticle on the center of mass of the target (fig. 31). If time does not permit the chief of section to announce the lead, it is estimated by the gunner.

(2) *Commands FIRE.* After AG and No. 2 call "Set" and "Ready," respectively, and when ready, the gunner commands FIRE.

37. Assistant Gunner

Duties of AG in direct firing are basically the same as in indirect firing (par. 23) except that the command to fire is received from the gunner rather than the chief of section.

38. Number 2

a. Duties. Number 2—

(1) Takes position to the left of the piece (fig. 32).
(2) *Sets announced quadrant.*
(3) Cross-levels the sight mount.
(4) Calls "Ready."

b. Detailed Description of Duties.

(1) *Takes position to the left of the piece.* No. 2 places himself to the left of the piece, outside the trail, at a point where he can operate the elevation knob and the cross-leveling knob of the sight mount without interfering with the gunner.
(2) *Sets the announced quadrant.* No. 2 rotates the elevation knob in the appropriate direction until the announced quadrant is read on the elevation and micrometer scales, opposite their appropriate indexes.
(3) *Cross-levels the sight mount.* No. 2 operates the cross-leveling knob to keep the bubble centered.
(4) *Calls "Ready."* No. 2 calls "Ready" when he has completed the duties given in (2) and (3) above.

39. Remainder of Section

The remaining cannoneers perform their duties as prescribed for indirect laying.

40. Reassignment of Duties

In the absence of any members of the howitzer section, the chief of section must reassign duties so that fire can be placed effectively upon the enemy.

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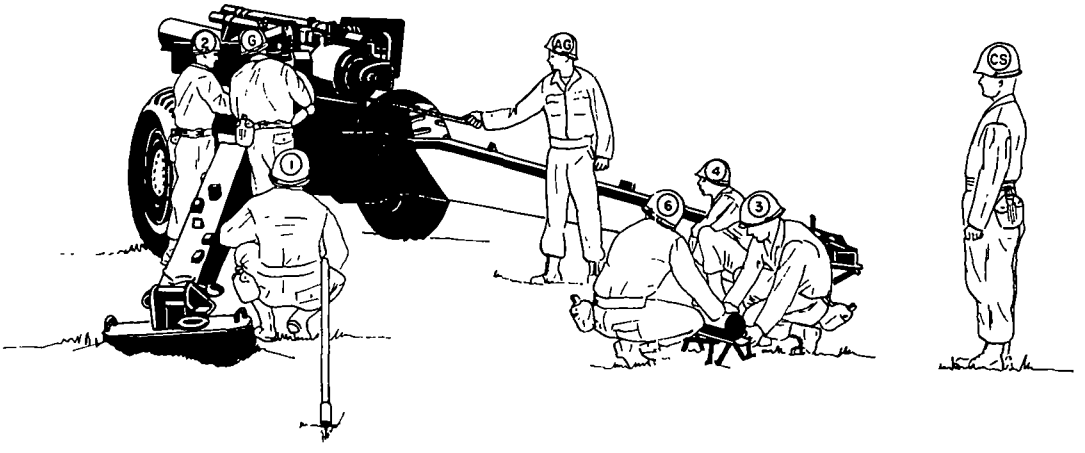

Figure 32. Servicing the piece in direct laying.

CHAPTER 6

TECHNIQUES AND SITUATIONS THAT REQUIRE SPECIAL ATTENTION

41. Precision in Laying

a. Sighting and laying instruments, fuze setters, elevating and traversing mechanisms must be operated properly to reduce the effects of lost motion. For uniformity and accuracy, the last motion in setting the instrument and in laying the piece should be in the direction prescribed in this manual. To insure accurate laying, personnel who are responsible for laying the piece must be required to verify the laying after the breech has been closed.

b. The line of sight in setting and reading a scale or centering a bubble should be at a right angle to the scale or level vial to prevent parallax errors. Bubbles should be centered exactly.

c. For uniformity and accuracy in laying on aiming posts, the vertical line in the reticle of the panoramic telescope should be alined with the left edge of the aiming posts.

42. Aiming Points and Displacement Corrections

a. General. After the piece has been laid initially for direction, it is referred to the aiming posts and, usually, to one or more distant aiming points. An aiming point must have a sharply defined point or vertical line clearly visible from the piece so that the vertical line of the panoramic telescope can be alined

on exactly the same place each time the piece is relaid.

b. Distant Aiming Point. A distant aiming point is one at sufficient distance so that normal displacements of the piece in firing or traverse will not cause a horizontal angular change in direction (with the same settings on the azimuth scales) of more than one-half mil. The executive officer usually designates the distant aiming point or points to be used.

c. Aiming Posts.

(1) Two aiming posts are used for each piece. Each post is equipped with a light for use at night. The most desirable distance from the piece to the far aiming post is 100 meters, considering accuracy of laying, visibility, and ability to control the aiming post lights. First, the far post is set up and alined. The near post is then set up and alined halfway between the far aiming post and the piece (par 22*b*(4)). The vertical line of the telescope must be on the left edge of the aiming posts for proper alinement. To insure equal spacing of aiming posts, the same man should pace the distance to both posts. Where ground conditions make pacing inaccurate, the distance from the piece to the posts may be measured by using the panoramic telescope and the aiming posts as measuring devices ((4) below).

(2) For night use, the aiming post lights should be adjusted so that the far light will appear several feet above the near light. The two

lights placed in this way will establish a vertical line for laying the piece. Whenever possible these lights should be attached to the aiming posts during daylight hours.

(3) Since the panoramic telescope is mounted at considerable distance from the center of rotation of the top carriage, large changes in deflection will cause misalinement of the aiming posts. Placing the aiming posts to the left front at a deflection of approximately 2400 when the piece is in the center of traverse will keep this misalinement to a minimum and still allow for maximum visibility (*d* below).

(4) To measure the distance from the piece to the aiming posts the stadia method may be employed, using the panoramic telescope and the aiming post as measuring devices. No. 5, when setting out the aiming posts, holds the upper section of one of the aiming posts in a horizontal position, perpendicular to the line of sighting. The gunner measures the length of this section in mils on the reticle of the panoramic telescope. For example, the upper section of the aiming post is 4½ feet long, so that it measures 14 mils when it is 100 meters from the piece. The proper location for the near post, in this case, would be at the point at which the 4½ foot section measures 28 mils. In many cases, the ideal spacing of 50 and 100 meters cannot be obtained but the posts will be properly spaced when the near post is set

at a point at which the 4½ foot section measures twice the number of mils it measured at the far post location. This measurement may be performed at night by attaching the night lighting devices at the 4½ foot marks on the aiming posts.

d. Correction for Displacement of Aiming Posts. When the gunner notes that the vertical line of the telescope is displaced from the line formed by the two aiming posts (or aiming post lights), he lays the piece so that the far aiming post (light) appears exactly midway between the near aiming post (light) and the vertical line (fig. 33). If the displacement is due to traversing the piece, the gunner continues to lay as described above. If the displacement is due to progressive shifting of the carriage from shock of firing or other cause, the gunner will notify the chief of section, who, at the first lull in firing, will notify the executive and request permission to realine the aiming posts. To realine the aiming post, the piece is laid with the far post midway between the near post and the vertical line (fig. 33). The far aiming post is moved into alinement with the vertical line of the telescope and then the near aiming post is alined. If terrain conditions make it impracticable to move one of the two aiming posts, the piece is laid for direction and referred to the aiming post which cannot be moved. This deflection is reported to the executive. The other post is alined by using the method described in paragraph 22*b*(4), and the azimuth micrometer scale is slipped to retain the same deflection that was used prior to realinement of the aiming posts.

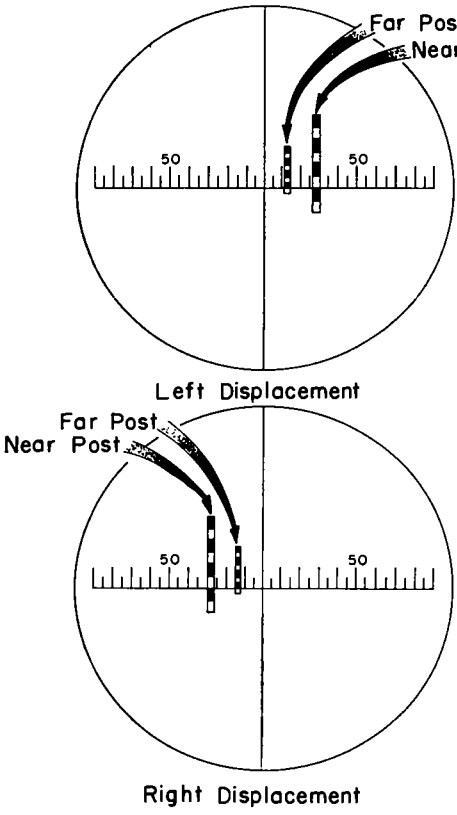

Figure 33. Gunner's sight picture of aiming posts in proper relationship when correcting for displacement.

43. Preparation of Position for Emplacement of Howitzer

a. General. For detailed information on the preparation of the howitzer position, see FM 5–15 and and FM 6–140. The piece should be emplaced on level ground to insure stability in firing and to reduce

the time needed for leveling the telescopes and range quadrant.

b. Spade Pits. Pits should be dug for the spades. On *very* soft ground, the spades can sometimes be seated by firing, but the displacement of the carriage will ordinarily be much greater than if the spades had been dug-in initially.

c. Recoil Pits. A recoil pit with a full 46-inch clearance between the breech and the ground must be dug for high-angle fire. After the piece has been emplaced and, if possible, seated, the piece will be elevated to maximum elevation, and a recoil pit dug that will insure proper clearance throughout the limits of traverse. When the weapon is not firing high-angle fire, the recoil pit should have an improvised cover to facilitate service of the piece.

44. Testing Targets

Testing targets will be more useful if the following improvements are made:

a. The target should be mounted on a flat piece of masonite, wallboard, or similar material.

b. To insure stability of the testing target throughout boresighting, it should be fastened to a stand in a manner similar to that shown in figure 34.

c. For use in either leveling or canting the test target (par. 55*a*) a mil scale may be inscribed at the bottom of the target. A small nail at the top marks the center from which the arc was drawn and provides a hook from which to suspend the plumb line (fig. 35).

d. Vertical reference lines may be drawn through the centers of each of the diagrams (fig. 36). These lines may be used when the trunnions cannot be

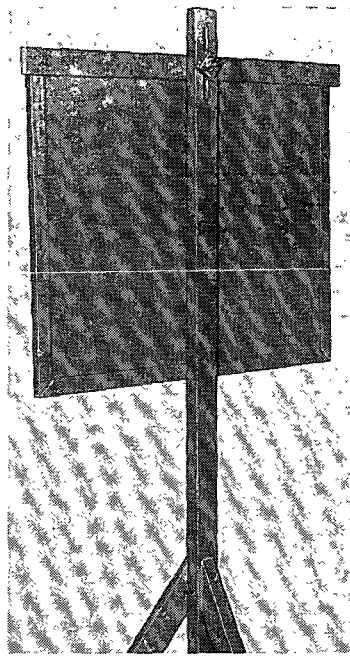

Figure 34. Rear view of boresighting target stand.

leveled, by setting the test target with the cant angle of the piece. The target is rotated until the line of sight through the tube tracks the reference line when the tube is elevated or depressed. Similarly, the panoramic telescope should be adjusted so that its reticle tracks the appropriate reference line when the tube is elevated or depressed.

e. To facilitate boresighting in darkness, bore a $\frac{1}{16}$-inch hole through the mounted testing target at the center of each aiming diagram. A flashlight held against the target behind the appropriate hole provides an aiming point for use in blackout con-

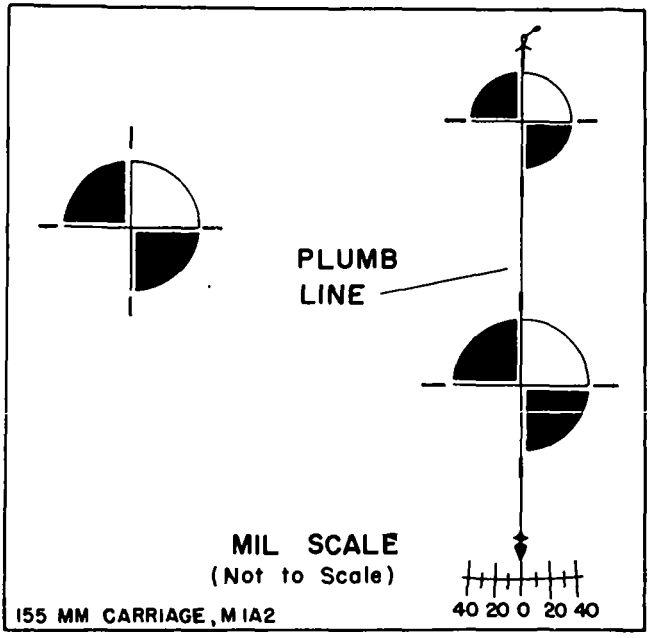

Figure 35. Mil scale inscribed on testing target.

ditions. Fasten patches of felt padding on the back of the target covering the regions of each hole so that light from the flashlight cannot be seen except through the hole. The flashlight must be lighted only after it is placed firmly in position. Care must be taken to prevent disturbing the position of the testing target.

45. Cease Firing

The command CEASE FIRING is normally given to the howitzer section by the chief of section, but in emergencies anyone present may give the com-

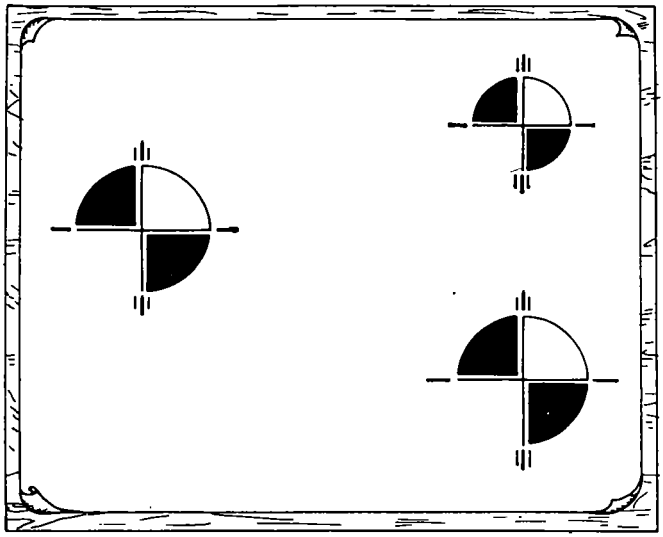

Figure 36. Vertical reference lines drawn on testing target.

mand. At this command, regardless of its source, firing ceases immediately. If the piece is loaded, the chief of section reports that fact to the executive. The executive acknowledges this report by saying "No. (so-and-so) loaded." If CEASE FIRING came from the fire direction center, firing is resumed at the announcement of the quadrant. If CEASE FIRING came from within the firing battery, the executive will investigate the condition that caused the command to be given. When the condition has been corrected, firing is resumed by the executive's announcement of the quadrant.

46. Changes in Data During Firing

a. Before Piece Is Loaded. The corrected data

is announced. The new data is set off, and firing is resumed at the announcement of quadrant.

b. After Piece Is Loaded. The command CEASE FIRE is given. If no change in the fuze setting is required or the piece is loaded with percussion-fuzed shell, the new data is set off and firing is resumed at the announcement of quadrant. If the piece is loaded with time-fuzed shell and the data requires a change in fuze setting, the chief of section will suspend firing and report this fact to the executive; for example, "No. 2 loaded, time (so such)." The piece will not be unloaded unless so directed by the executive. In continuous fire, changes in data are so applied as not to stop the fire or break its continuity.

47. To Unload the Piece

a. A complete round, once loaded, should always be fired in preference to being unloaded, unless military necessity dictates otherwise.

b. The command is UNLOAD. Unloading is performed under the immediate supervision of an officer. He inspects the head of the rammer to insure that it is free from obstructions. The round is unloaded as follows:

(1) Gunner depresses the tube to zero elevation.

(2) AG removes the firing mechanism, opens the breech, and removes the powder charge, and passes it to No. 5. No. 3 passes waste to AG who places it in the chamber and closes the breech.

(3) No. 1, assisted by No. 4 if necessary, inserts

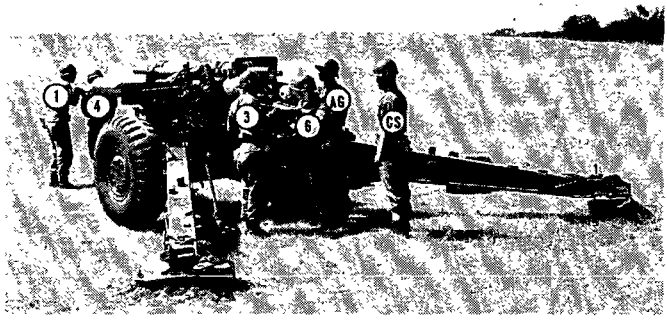

Figure 37. Unloading the piece.

the rammer head into the muzzle of the piece until the head incloses the fuze and comes in contact with the projectile. He pushes firmly, tapping if necessary, until the projectile is loosened.

(4) AG opens the breech and removes the waste.

(5) Nos. 3 and 6 place the lip of the loading tray in the breech recess as described in paragraph 26*b* and receive the projectile as it is slowly pushed out by Nos. 1 and 4, as shown in figure 37.

(6) Nos. 3 and 6 then return the projectile to No. 2 who resets the fuze.

c. For further information on unloading, see FM 6–40 and TM 9–331A.

d. In case of a misfire, the instructions contained in paragraph 82 and TM 9–331A will be followed.

48. Care of Ammunition

a. To insure uniform results in firing, to prolong the life of the tube, and to avoid accidents, care must

be exercised in the storage and handling of ammunition at the battery. Provisions of TM 9–1900 applicable to field service should be followed carefully. In the field, conditions existing in each position will determine the amount of time, labor, and materials required to store and preserve the ammunition adequately. If the position is to be occupied for only a few hours, a tarpaulin spread on the ground may be sufficient; for longer periods of time, more adequate facilities should be provided.

b. Ammunition must be protected from damage. When ammunition is received, it should be sorted into lots and placed in the best available storage. Powder temperature should be kept as uniform as possible. Ammunition data cards should be kept until after all ammunition for that lot is expended. Ammunition should be left in containers until its early use is expected. Protection should be provided against moisture, dirt, direct rays of sun, and, as far as practicable, hostile artillery fire and bombing. Protection against weather, dirt, and sun may be obtained by the use of tarpaulins below and above the ammunition and dunnage between the layers. Protection against hostile fire may be obtained by the use of small dispersed stacks, trenches, or dugouts. Each stack should contain not more than 50 rounds and should be not more than three layers high. Stacks should be at least 10 meters apart.

c. For further information on care of ammunition, see FM 6–40, TM 9–331A, TM 9–1900, and TM 9–1300–205.

49. Section Data Board

When positions are occupied for more than a few hours, data boards may be used by each section for recording such items as deflections to aiming points, calibration corrections when appropriate, minimum quadrant, data for barrages and counter preparations, and other data which may be needed quickly. If such information assumes a standard pattern, the section may paint a form on the back of the shield and chalk in the various items of information in the appropriate spaces.

CHAPTER 7

BORESIGHTING AND BASIC PERIODIC TESTS

Section I. GENERAL

50. Purpose and Scope

The purpose of this chapter is to outline the procedures for boresighting and making basic periodic tests of on-carriage fire control equipment. The procedures covered will include only those that may be accomplished at battery level.

51. Equipment

The following equipment is needed for performing boresighting and periodic tests:

a. Boresights. Front and rear boresights or improvised substitutes are necessary for both boresighting and testing. If boresights are not available, crosshairs may be fastened on the muzzle, and the obturator spindle vent in the breechblock may be used as a rear sighting guide by removing the firing lock from the closed breechblock.

b. Testing Target. A testing target or suitable substitute is required for both boresighting and testing. If a testing target is not available, a clearly defined aiming point 2,500 or more meters from the piece may be used to accomplish approximately the same purpose as the testing target.

c. Tools. The section equipment includes all the necessary tools for boresighting and testing. Care

must be taken in using the screwdrivers and wrenches to insure that damage does not result through carelessness or the use of inappropriate tools.

d. Plumb Line. It is essential that a plumb line be used in the basic periodic test in order to obtain maximum accuracy. The farther from the piece that the plumb line is placed, the longer the line must be. For example, to be effective at 5 feet in front of the howitzer tube, the line must be approximately 37 feet long. To keep such a long plumb line taut it may be necessary to add weight to it. Wrenches or rocks may be used. The tendency of

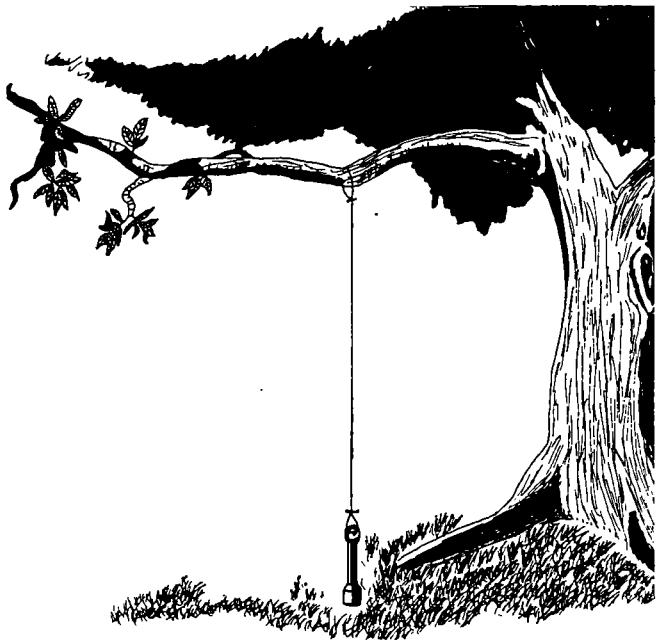

Figure 38. Plumb line suspended from tree.

the weight to swing may be decreased by placing a bucket containing water or other liquid under the plumb line so that the plumb bob or other weight is partially immersed in the liquid. If a convenient means of suspension is not readily available, a pole may be employed. A plumb line strung from a building or tree, as in figure 38 is more desirable and should be used if possible. Units in garrison may find it convenient to rig a plumb line on a building. The line then can be nailed in place permanently.

Section II. BORESIGHTING

52. General

a. Description. Boresighting is the process by which the optical axis of the panoramic telescope is made parallel to the line of sight through the center of the tube. It consists of those tests and adjustments that are performed by section personnel to insure accuracy in laying for elevation and direction. The piece should be placed near its center of traverse prior to boresighting. All instruments and mounts must be positioned securely; there must be no free play. Boresighting is conducted before firing and, when necessary, during lulls in firing.

b. Methods. Four methods of boresighting the 155-mm howitzer are—

(1) Testing target.
(2) Distant aiming point.
(3) Aiming circle.
(4) Standard angle.

c. Leveling. Prior to starting the tests, the piece should be placed in its center of traverse. Although it is not absolutely necessary to level the trunnions

for boresighting, it is advisable to do so whenever possible. Accurate results can be obtained more readily if the trunnions are level, because a corresponding tilt does not have to be introduced in the panoramic telescope mount and in the testing target. The trunnions should be leveled by leveling the ground under the trails or by blocking up one trail. The amount of cant of the trunnions can be determined by leveling a gunner's quadrant placed at right angles to the tube on the counterrecoil piston rod lug (fig. 39). If available, a piece of machined steel or glass with smooth sides and uniform thickness can be used as a base for the quadrant. In no case should there be more than 20 mils cant.

(1) *Plumb line.* The best method to check leveling is by means of the plumb line. The line is suspended approximately 5 feet directly in front of the axis of the bore. When the trunnions are level, the line of sight should track the plumb line as the tube is depressed and elevated throughout the limits of elevation, deviating from the line by no more than the thickness of the crosshair on the muzzle boresight. If the trunnions are not exactly level and the cant is only slight, the trunnions can be leveled by traversing the tube from center and shifting the trails to bring the line of sight back on the plumb line. Elevate and depress the tube to determine whether it more nearly tracks the plumb line. Repeat this experiment until the line of sight tracks the plumb line exactly.

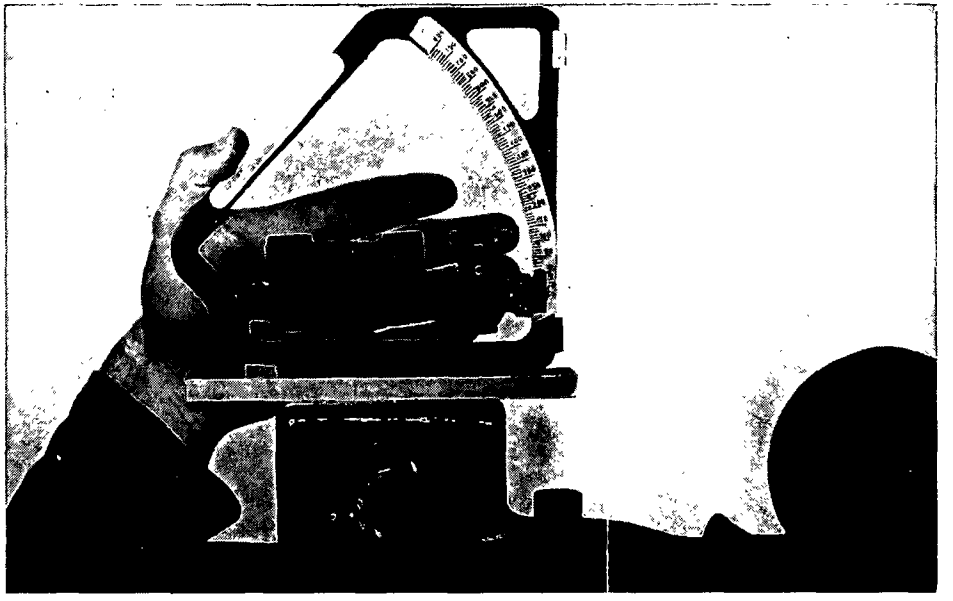

Figure 39. Leveling the trunnions.

(2) *Gunner's quadrant.* In leveling operations using the gunner's quadrant, a quadrant that has been tested (par. 58) and found to be accurate is required.

(3) *Piece not level.* When it is impossible to level the trunnions, the cross-level bubbles cannot be used. If the tube cannot be leveled, the longitudinal-level bubble cannot be used. To permit boresighting when either of these conditions exists, lines should be scribed on the sight mount after a basic periodic test (par. 57) when the mount is in correct adjustment. These scribed lines can be matched later, when leveling is impossible, to retain the same relationship between the axis of the bore and moving parts of the on-carriage sighting equipment. After a basic periodic test with the tube and sighting equipment in perfect alinement, use a knife blade or other sharp metal point to scribe the following lines: (1) straight across the junction of the cross-leveling segment and the cross-leveling worm housing of the panoramic telescope mount (fig. 40①); (2) straight across the junction of the cross-leveling worm knob shaft and the cross-leveling worm housing (fig. 40②); and (3) straight across the junction of the inner and outer rings of the sight mount body (fig. 40③). Care should be taken that the lines are scribed in the paint *only* and are not cut into the metal. Fill the scribed lines with *white* paint and wipe off the excess. If conditions prevent

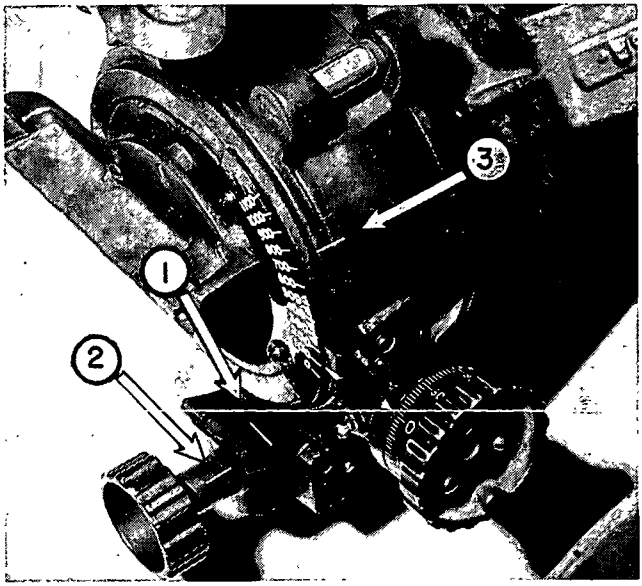

Figure 40. Scribed lines for positioning mount.

boresighting with the tube level, longitudinal compensation for an unlevel (elevated or depressed) tube may be made by matching the scribed lines.

53. Conditions

The on-carriage sighting equipment of the weapon is in correct adjustment when the following conditions exist:

a. Mounts and instruments are securely attached and there is no binding or excessive backlash between gears.

b. The line of sight of the panoramic telescope is

parallel to the axis of the bore throughout the limits of elevation.

c. All scales and indexes read zero.

d. All bubbles are leveled.

54. Testing Target Method

a. General. It is essential that the proper testing target be used. If a testing target is not available, a substitute may be constructed in accordance with dimensions given in TM 9-331A. The testing target method consists of making the line of sight of the panoramic telescope parallel to the axis of the tube, using the aiming diagrams of the testing target as aiming points. The steps to be followed are as follows:

(1) *Trunnions.* Level the trunnions as exactly as possible (par. 51*c*).

(2) *Tube.* Using the gunner's quadrant on the leveling plates of the breech ring, level the tube. Make certain that the shoes on the gunner's quadrant are positioned between the engraved lines on the leveling plates.

(3) *Actuating arm pivot.* To establish proper relationship of the sight mount with the tube when boresighting, cross-level the telescope mount and place the gunner's quadrant on the quadrant seat attached to the front of the mount (par. 59*c*). The gunner's quadrant should show zero elevation within one-half mil. If it does not, loosen the two capscrews which hold the actuating arm bracket of the telescope mount to the mounting bracket. Using a screwdriver, turn the eccentric adjusting screw (fig. 41)

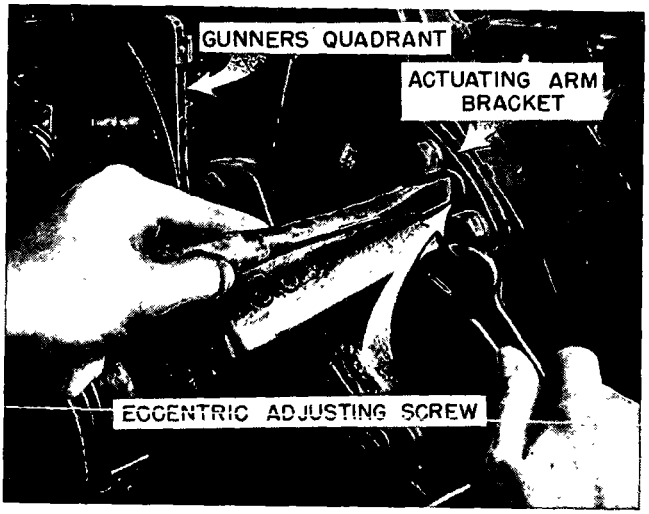

Figure 41. Adjusting the actuating arm pivot.

on the actuating arm bracket until the gunner's quadrant reads zero elevation. Tighten the capscrews and verify the adjustment.

(4) *Elevation scale.* Center the longitudinal-level bubble by means of the elevation knob. The elevation scale should read zero. If it does not, adjust the elevation scale by loosening the clamping screws and shifting the scale plate until its zero is directly opposite the index (fig. 42). Retighten the clamping screws and check the level.

(5) *Elevation micrometer index.* If the elevation micrometer index does not read zero, loosen the three small setscrews on the elevation knob and slide the micrometer to

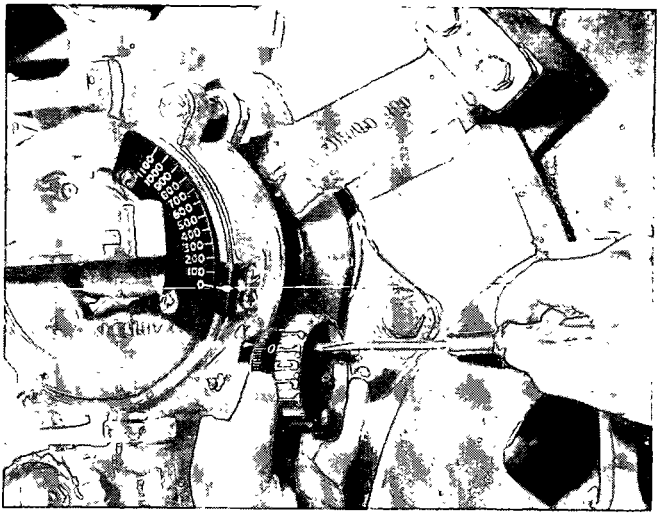

Figure 43. Shifting elevation micrometer index to zero.

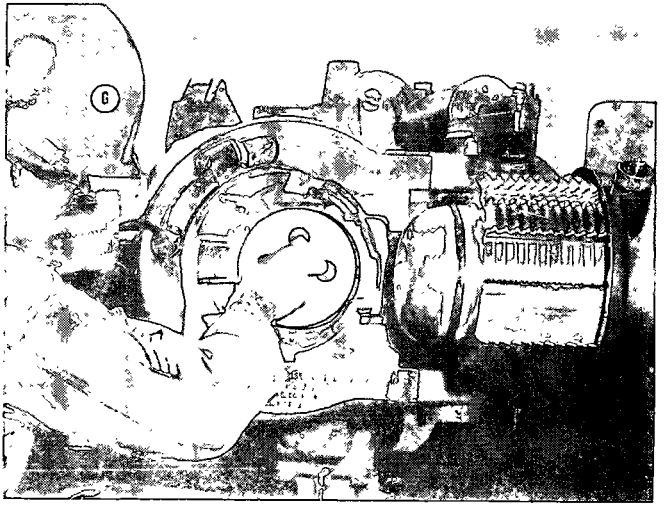

Figure 44. Emplacing the breech boresight.

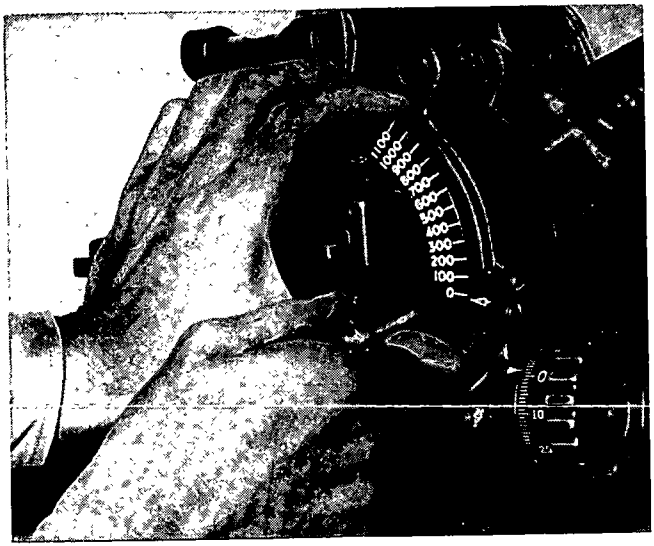

Figure 42. Shifting elevation scales into coincidence.

aline the zero with its index (fig. 43). Retighten the setscrews, check the reading to see that the scale did not slip, and check the level.

(6) *Boresights.* Place the breech (fig. 44) and muzzle boresights in their proper position.

(7) *Testing target alinement.* Without moving the piece, aline the lower right testing target with the line of sight through the tube (fig. 45). (When testing target reference lines are used, the tube may be elevated and depressed slightly to insure that the testing target is properly alined. If necessary to move the tube to verify the alinement, relevel the tube). The target should be

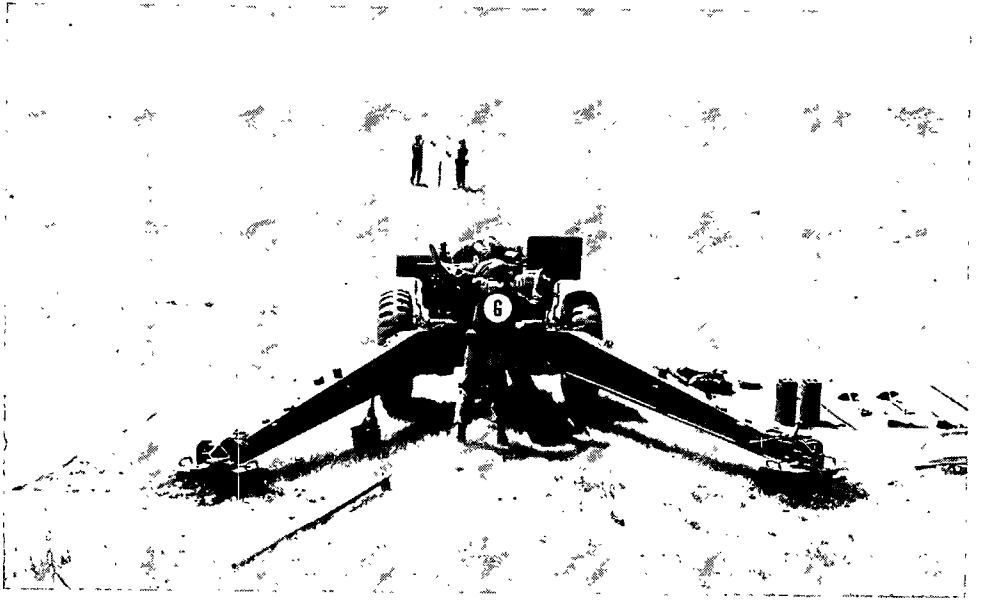

Figure 45. Alining the testing target.

located at least 50 meters in front of the muzzle. If uneven ground makes it necessary to elevate or depress the tube slightly to make the alinement, position the sight mount as described in (9) below.

(8) *Cant compensation.* If the tube and trunnions are level, the face of the target must be vertical and the horizontal centerlines of the aiming diagrams must be level. This may be ascertained by means of a plumb line attached to the testing target (fig. 35). If the trunnions are slightly canted (par. 51*c*), the target must be canted an equal amount in the same direction. If the tube is not level longitudinally, the face of the target must be tilted accordingly. In all cases, the face of the target must be positioned so that it is at right angles to the line of sight through the tube and the horizontal centerlines of the aiming diagrams are parallel to the axis of the trunnions.

(9) *Sight mount.* When the tube is not level or there is cant in the trunnions, position the sight mount by matching the white scribed lines as shown in figure 40. The lines are cut into the paint at a time, preferably after a basic periodic test, when the telescope is in exact adjustment. The lines are filled with white paint and the excess paint wiped off. These white lines may be matched later for controls for zero settings of the sight mount. If, with the white scribed lines matched, the elevation or micrometer scales do not read zero, shift their indexes to zero as pre-

scribed in (4) and (5) above. *Thereafter, keep the elevation scale and micrometer set at zero during the boresighting operation.* The longitudinal bubble is then no longer used in the operation. Scribed lines may be used in the testing target method of boresighting with the trunnions or tube not level, with the distant aiming point method of boresighting, and in direct fire when the slipping azimuth micrometer scale has been shifted.

b. Panoramic Telescope Lateral Alinement. Assuming that all lost motion has been eliminated (par. 40) and that the cross-level bubble is in adjustment (par. 59), cross-level the telescope mount or match the scribed lines (*a*(9) above). Zero the sight as in paragraph 22*b*. Sight through the telescope. If the vertical line of the reticle is not in alinement with its aiming diagram, loosen the tangent locking screws (fig. 46) and adjust the tangent screws (fig. 47) until the vertical line of the reticle is properly alined. Tighten the locking screws and verify the adjustment. If the limit of this adjustment is inadequate, refer the telescope and mount to the authorized ordnance maintenance personnel for correction.

c. Panoramic Telescope Horizontal Alinement. Next, if the horizontal hair of the reticle does not fall exactly over the horizontal line of the aiming diagram, turn the elevation knob of the telescope (fig. 48) until it is alined properly. Loosen the clamping screws (fig. 49) and shift the elevation micrometer until the fine elevation indexes are matched (fig. 50). Tighten the locking screws and verify the adjustment.

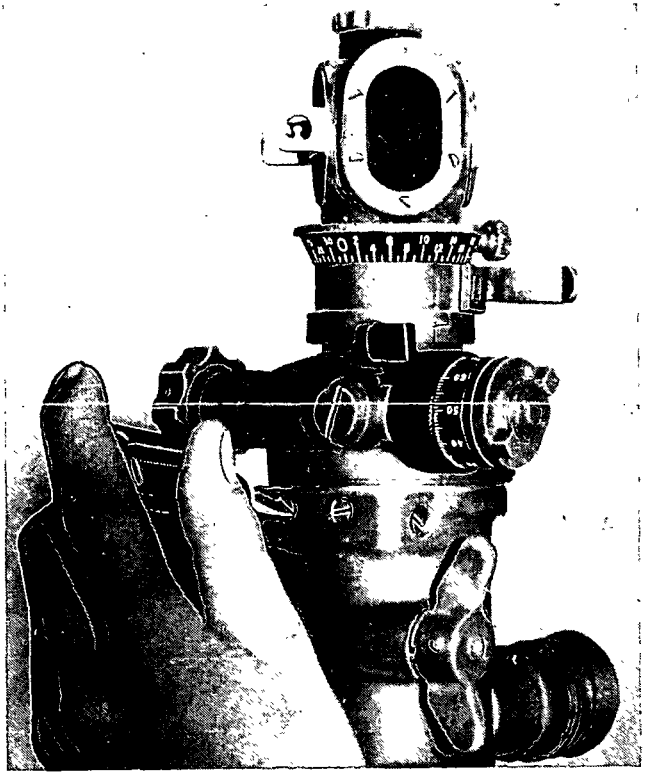

Figure 46. Loosening a tangent locking screw.

55. Distant Aiming Point Method

A distant aiming point may be used instead of the testing target if the testing target is not available or its use is impracticable. This method consists of alining the line of sight through the tube and the panoramic telescope on a common point at least 2,500 meters from the piece. The step prescribed for the testing target method (pars. 53*a* (1), (3), (4), and

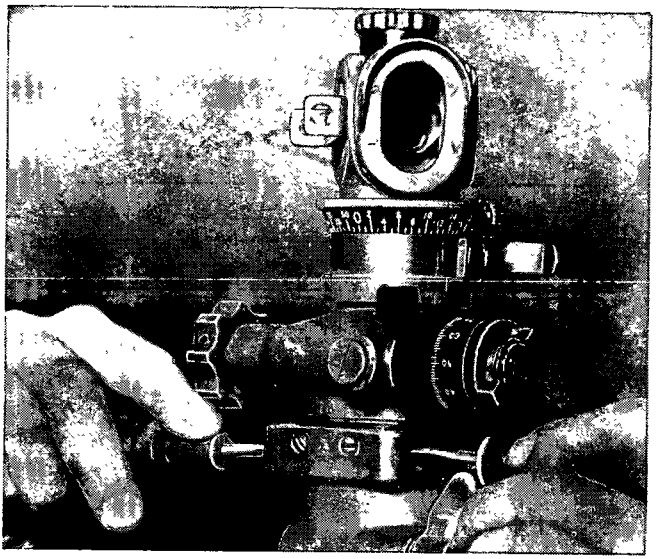

Figure 47. Adjusting the vertical line of the reticle with tangent screws.

(5), *b*, and *c*) apply except that the boresights and the panoramic telescope are alined on the same point instead of on displaced points as on the testing target. Accurate cross-leveling of the trunnions is unnecessary when boresighting on a distant aiming point because the lines of sight converge on a single point. Normally, the tube will not be level, so the scribed lines (par. 51*c*(3)) will be used. *Therefore it is essential that white scribed lines of the telescope mount be matched throughout the remainder of the sighting operation.*

56. Aiming Circle Method

a. General. The aiming circle method may be used when weather or terrain conditions prohibit the

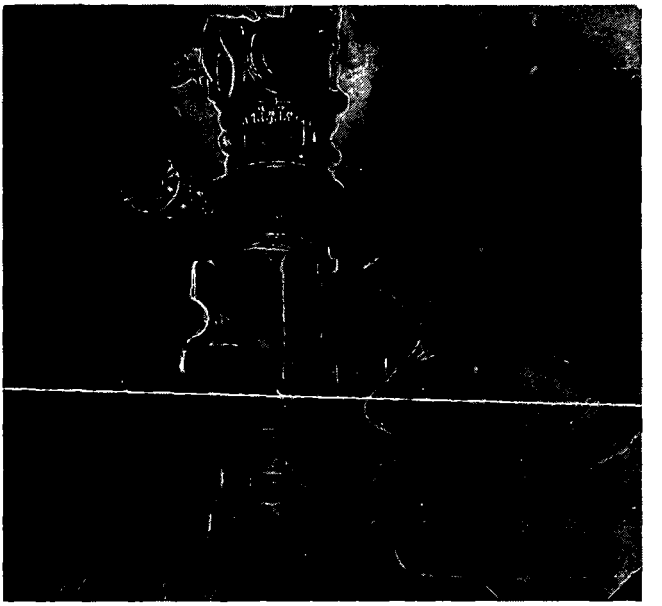

Figure 48. Alining horizontal reticle by turning elevation knob.

use of the testing target method or the distant aiming point method. The aiming circle method is used only for correcting deflection errors. It does not include a test for determining elevation errors. When this method is used, any adjustments made should be verified at the first opportunity by boresighting on a testing target or a distant aiming point. Before boresighting with the aiming circle, certain preparatory steps (*b* below) must have been performed, preferably after a basic periodic test (pars. 57–59) when the panoramic telescope mount was in correct adjustment.

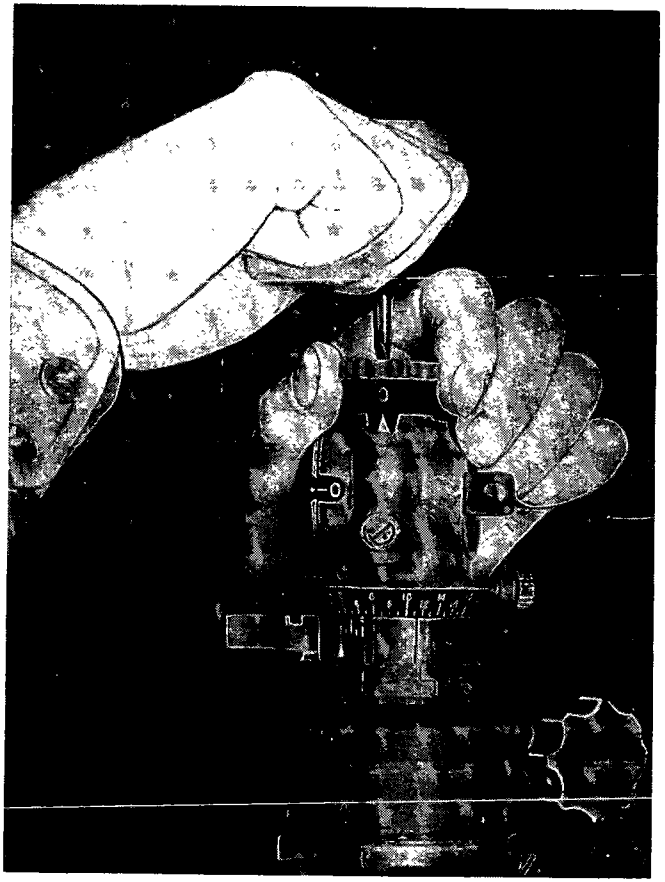

Figure 49. Tightening clamping screws.

b. Preliminary Operations.

(1) *Accuracy.* The greatest care must be exercised in all phases of these operations. All final movements of the instruments must be made so that the reticles approach the

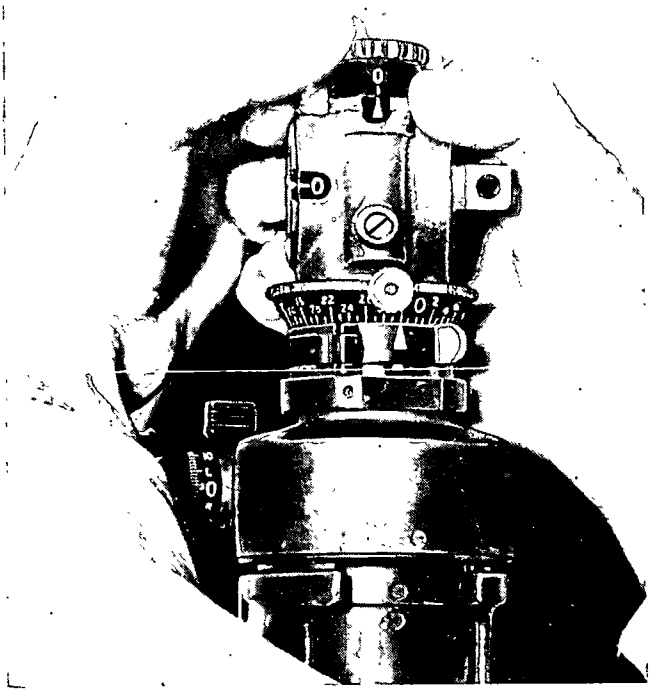

Figure 50. Shifting zero of the elevation know to its index.

final position from left to right in order to eliminate the effects of lost motion in the gears.

(2) *Parallax.* Parallax in the aiming circle and the panoramic telescope must be eliminated. This is done with the aiming circle by placing in front of the eyepiece lens a dark-colored cardboard or metal parallax shield of the same diameter as the eyepiece lens housing. The shield should have a

vertically and horizontally leveled slot 1/16-inch wide and 1/4-inch long. It is placed in front of the eyepiece with the slot in the vertical position. To eliminate parallax in the panoramic telescope, a shield of the same diameter as the eyepiece lens housing and having an exactly centered hole 1/16-inch in diameter is mounted in front of the eyepiece lens (fig. 51). A more permanent parallax shield may be constructed of brass or bronze shim stock. When the shield is constructed of metal, a series of fingers approximately 3/16-inch wide and 1/4-inch long separated by 1/4-inch spaces should extend beyond the perimeter of the shield. These fingers should be bent along the circumference of the circle until they form an angle of 90° with the surface of the shield. The fingers serve as a means of clipping the shield in place quickly and permit easy removal. When the eyepiece has a rubber eyeguard, the fingers permit alinement within the guard without its removal.

(3) *Boresight marks* (*trunnions level*). The aiming circle method requires that boresight marks be located on the top surface of the tube at the muzzle end and on the rear of the breech ring. The position of these boresight marks must be accurately defined by painting a white stripe about 1-inch wide and several inches long on the tube; on the breech ring it should extend from the top down through the breechblock

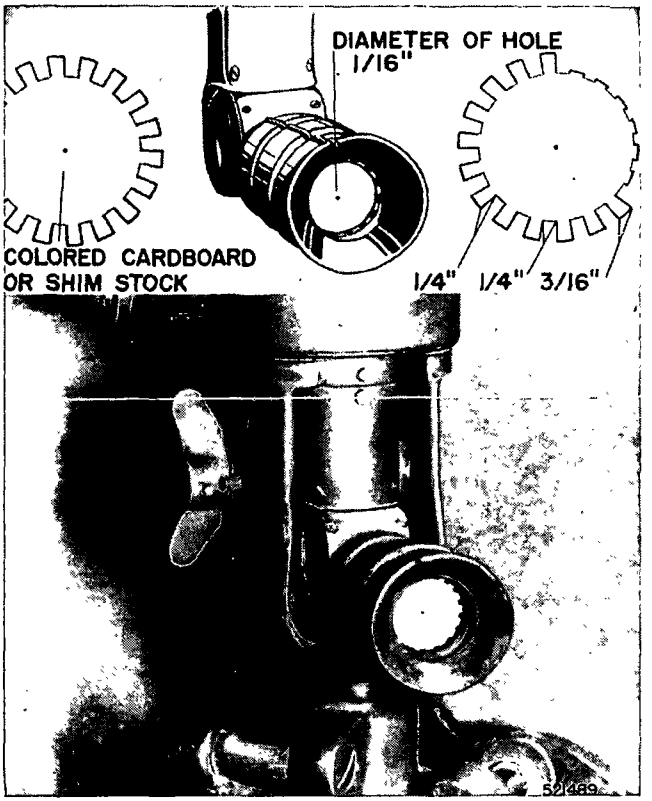

Figure 51. Parallax shield.

driver. The left edge of the stripe lies in the same vertical plane as the exact center of the bore when the trunnions are level. The location of boresighting marks is determined as follows:

(*a*) Level the trunnions.

(*b*) Set up an aiming circle equipped with

a parallax shield 30 to 50 meters directly in the rear of the piece.

(*c*) Fasten crosshairs in the muzzle witness marks.

(*d*) With adhesive tape, fasten a bright common pin in the top witness mark so that it projects above the muzzle.

(*e*) Place the breech boresight in place with two finger holes vertical.

(*f*) Place a straightedge in a vertical position on the rear face of the breech ring and aline the right side of the straightedge with the center hole of the breech boresight and the vertical thread on the muzzle.

(*g*) Sight through the aiming circle and, if necessary, traverse the piece until the pin mounted on the muzzle and the right side of the straightedge are alined with the right edge of the vertical hair of the aiming circle. Recheck the alinement of the straightedge with the boresight. Draw a pencil line along the right side of the straightedge on the upper rear portion of the breech ring.

(*h*) Lay the straightedge atop the tube at the muzzle along the same line of sight and draw a pencil line.

(*i*) Paint the white stripe on the tube, the left edge of the stripe exactly on the pencil line.

(*j*) Remove the breech boresight and close the breech. Using the straightedge and the same line of sight, extend the breech

pencil line ((*f*) above) to the breechblock carrier. Paint a white stripe on the breech, the left edge of the stripe exactly on the pencil line.

(4) *Boresight marks* (*trunnions not level*). The procedure for boresighting when the trunnions are not level is the same as (3) above with the addition of a radius point which is located on the breechblock driver as follows:

(*a*) Open the breech. Depress the tube until the crosshairs of the reticle of the aiming circle are directly centered on the muzzle boresight. Close the breech.

(*b*) Measure the *outside* diameter of the muzzle. Divide this measurement by two, thereby obtaining the radius and lay off this distance on the straightedge.

(*c*) Place the right edge of the breech boresight along the left edge of the breech boresight stripe, the base of the straightedge resting on the horizontal hair (fig. 52).

(*d*) Keeping the straightedge in place, turn the elevating knob to elevate the aiming circle so that the crosshairs rest on the radius mark on the straightedge (fig. 53).

(*e*) Now turn the straightedge horizontally against the breechblock driver, alining the lower edge of the straightedge with the upper edge of the horizontal hair of the aiming circle (fig. 54). Mark the point where the lower edge crosses the left edge of the breech boresight stripe (fig. 55).

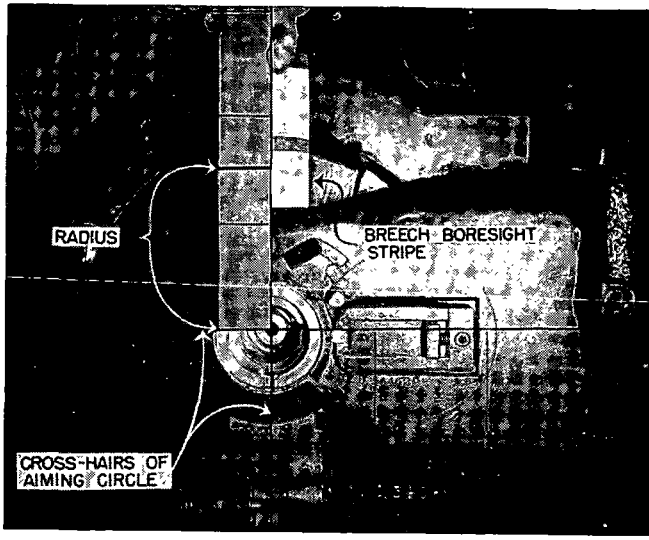

Figure 52. Locating the radius point (crosshairs of aiming circle centered on bore).

(*f*) Paint a short white line to the left, the top of the line being an extension of the radius point.

c. Procedure (Trunnions Level). With the piece prepared as in *b* above, at any later time the piece may be boresighted by the aiming circle method as follows:

(1) Set up the aiming circle 30 to 50 meters in rear of the piece.
(2) Level the aiming circle and zero the scales.
(3) Elevate the piece until the two boresighting marks are plainly visible from the aiming circle. Do not elevate the tube any more than is necessary for clear definition of the edges of the white boresight marks.

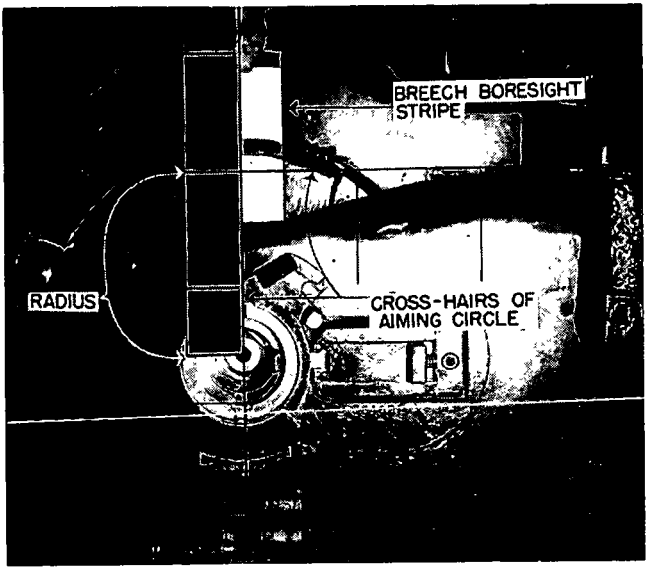

Figure 53. Locating the radius point (crosshairs of aiming circle centered on radius point).

(4) By traversing the piece and turning the lower motion of the aiming circle, place the right edge of the vertical hair exactly in line with the left edge of the two boresight stripes (fig. 56).

(5) Check that the trunnions are level by elevating and depressing the tube and noting if the two boresight stripes remain parallel to the right edge of the vertical hair of the aiming circle. If the trunnions are level, the radius point is not used. Proceed as in (6) through (10) below. If the trunnions are *not* level, proceed as in *d* below.

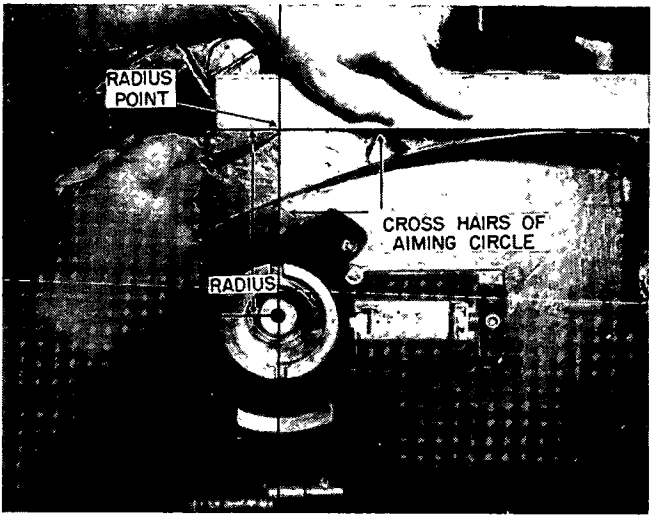

Figure 54. Marking the radius point.

(6) Verify that the azimuth scales of the telescope are set at zero and that the indexes are in coincidence.

(7) With the upper motion of the aiming circle, turn to the objective lens of the panoramic telescope. Make certain that equal amounts of the housing appear on each side of the vertical hair.

(8) Read the angle on the azimuth scales of the aiming circle.

(9) Set the angle from the aiming ((8) above) on the azimuth micrometer scale of the panoramic telescope.

(10) Adjust the tangent screws on the panoramic telescope until the vertical hair of the

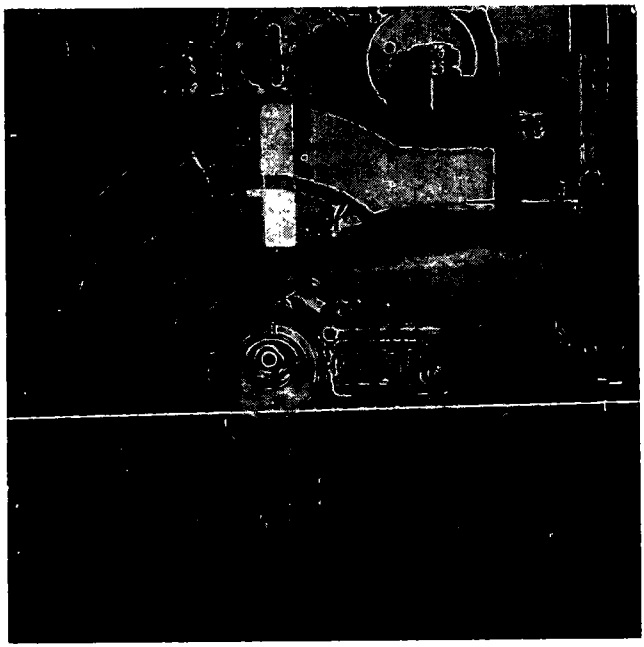

Figure 55. Breech bore stripe with radius point indicated.

telescope is exactly on the center of the objective lens of the aiming circle. Recheck the angle settings and the alinement of the vertical hairs.

d. Procedure (Trunnions Not Level). When the trunnions are not level, the procedure for boresighting is as prescribed in *c* (1) through (4) above. Sighting on the boresight stripes must be made at prescribed points on the stripes when the trunnions are not level. The right edge of the vertical hair of the aiming circle must be alined with the top left edge of the muzzle boresight stripe and with the

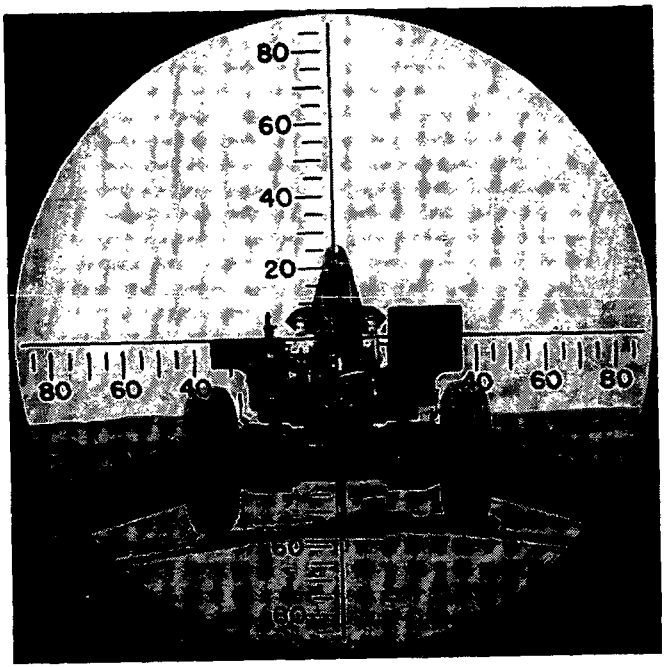

Figure 56. Right edge of vertical hair in aiming circle alined with left edge of boresighting stripes.

radius point on the left edge of the breech boresight stripe (fig. 57). These two points are equally distant from the axis of the bore. If sighting is not done exactly on these two points when the trunnions are not level, the line of sight through the aiming circle will not be parallel to a vertical plane through the axis of the bore and an error in alinement will result. After alining the boresighting points, the boresighting procedure is the same as in *c* (6) through (10) above.

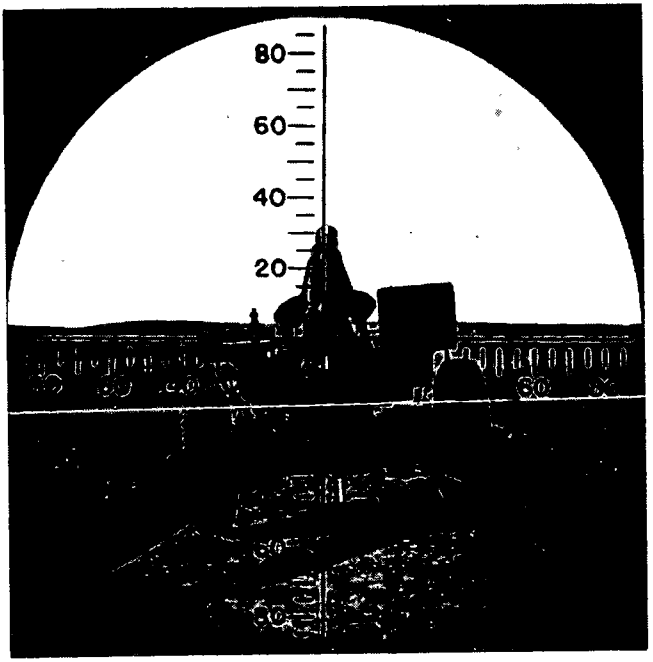

Figure 57. Right edge of vertical hair of aiming circle alined with radius point on breech and front end of muzzle bore-sighting stripe.

57. Standard Angle Method

a. General. Conditions may exist when the bore-sighting marks previously described, are impracticable. Under such circumstances the alinement of the optical axis of the panoramic telescope parallel to the axis of the bore may be tested and adjusted by referring to a selected point on the muzzle. The deflection and elevation angles necessary to refer the line of sight of the telescope to the selected point on the muzzle are referred to as the standard angles.

Once they have been determined, they may be used for a quick test of the alinement of the panoramic telescope when more precise methods cannot be used. Misalinement discovered and corrected as a result of this test should be verified by a more accurate method at the earliest opportunity. When using the standard angle method of boresighting, be sure that the recoiling parts are in the same position with respect to the nonrecoiling parts as they were when the standard angles were determined. The recoil system must be checked to see that it contains the proper amount of recoil oil before determining the standard angles.

b. Preliminary Operations. An ideal time to determine the standard angles for later use is during the basic periodic test, when the panoramic telescope is known to be in correct alinement. The procedure for determing standard angles is as follows:

(1) After checking the recoil system and with the tube in battery, mark the normal position of parts that move in recoil with respect to parts that do not move in recoil. This is done by carefully measuring the distance from the end of the tube to the wiper. Record this distance.
(2) Carefully level the trunnions.
(3) Boresight the piece by using a testing target.
(4) With tape, fasten a bright common pin in the left horizontal witness mark. Allow the pin to project to the left of the muzzle (fig. 58).
(5) Fasten the parallax shield over the eyepiece (fig. 51) of the panoramic telescope.

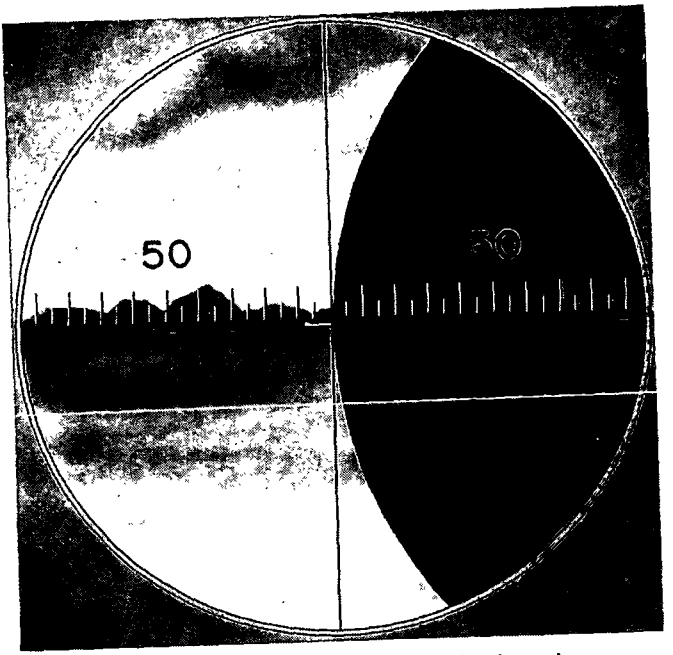

Figure 58. Sight picture of projecting pin.

(6) Verify that the coarse and fine elevation indexes on the telescope are at zero.

(7) By turning the sight mount elevation knob and the azimuth micrometer knob, place the crosshairs of the sight on the pin ((4) above).

(8) Refer the telescope to the junction of the pin with the muzzle (fig. 58).

(9) Verify that the cross-level bubble is centered and that the horizontal and vertical lines of the telescope are exactly on the junction of the pin with the muzzle.

(10) Read and record the deflection from the panoramic telescope to the nearest ¼-mil. (Since the graduations are to the nearest mil, it is necessary to interpolate to the nearest ¼-mil.) This is the standard azimuth (horizontal) angle for the piece tested.

(11) Read and record the elevation on the elevation scale to the nearest ¼-mil. This is the standard elevation (vertical) angle for the piece tested.

(12) With a knife blade or other sharp point, scribe lines in the paint on the parts of the panoramic telescope mount as in paragraph 51*c*(3).

(13) Fill the scribed lines with *red* paint and wipe off the excess paint.

c. Procedure. Once the standard angles have been determined, the standard angle method of boresighting is performed as follows:

(1) Verify that the parts that move in recoil are in the same position with respect to the nonrecoiling parts as they were when the standard angles were determined. If they are not in the same position, the amount of recoil oil in the recoil mechanism must be modified until the distance from the end of the tube to the wiper is the same as the recorded measurement (*b*(1) above).

(2) Verify that the trunnions are not canted more than 20 mils; if convenient, level the trunnions.

(3) With tape, fasten a pin in the left horizontal witness mark so that the pin projects out to the left of the muzzle.

(4) Place the parallax shield on the eyepiece of the telescope.

(5) Bring the red scribed lines into coincidence, refining the setting by turning the elevation micrometer knob to the standard elevation angle (*b*(11) above).

(6) Set off the standard elevation angle on the panoramic telescope.

(7) If the vertical line of the reticle is not exactly on the junction of the pin and the muzzle, adjust the tangent screws until the vertical line of the reticle is properly alined.

(8) If the horizontal line of the reticle is not exactly on the junction of the pin and the muzzle, turn the elevating knob of the panoramic telescope until it is properly alined. Adjust the zero of the elevation knob scale so that it is in alinement with the index.

Section III. BASIC PERIODIC TESTS

58. General

Basic periodic tests are performed by the section under the supervision of the battery executive and the artillery mechanic. These tests are performed at the discretion of the unit commander. Suggested times for performance are once each year if the piece is used only for nonfiring training; once every 3 months if the piece is fired; as soon as possible after extensive use, accidents, or traversing extremely rough terrain; and whenever the piece fires inaccurately for no readily apparent reason. The tests reveal whether or not the on-carriage sighting equip-

ment, the gunner's quadrant, and the fuze setter are in correct adjustment.

a. Conditions. To insure correct adjustment of on-carriage fire control equipment, the conditions in (1) through (5) below must exist. These conditions apply to both deflection and elevation measuring instruments.

(1) The trunnions are level.

(2) The line of sight of the panoramic telescope remain in a plane parallel to the vertical plane passing through the axis of the bore as the weapon is elevated throughout its limit of elevation.

(3) Keeping the sight mount longitudinal-level bubble centered, the cross-level bubble remains centered throughout the limits of elevation of the tube.

(4) With the tube level, the sight mount longitudinal-level bubble remains centered when the movable cross-level segment is operated throughout its limits.

(5) With the scales set at zero, the longitudinal-level bubble centers when the tube is level.

b. Preparations.

(1) Place the piece on a site that is as near level as possible.

(2) Boresight the piece as prescribed in paragraph 54.

(3) Suspend a plumb line (par. 50*d*) approximately 5 feet in front of the muzzle, or, if a fixed plumb line is used, position the vehicle so that the tube is 5 feet from it.

(4) Prepare a parallax shield for the panoramic

telescope (par. 55) to eliminate parallax when viewing plumb line at close range.

59. Test of Gunner's Quadrant

a. General. The gunner's quadrant must be in proper adjustment before conducting tests and adjustments of other sighting and fire control equipment. Inspect the shoes of the gunner's quadrant for dirt, nicks, or burrs. Similarly, inspect the leveling plates on the upper surface of the breech ring and the quadrant seats on the sight mount. Dirt, nicks, or burrs on these surfaces will cause the instrument to give inaccurate readings.

b. End-for-End Test.

(1) Zero the gunner's quadrant, making sure the auxiliary indexes match.

(2) Place the quadrant on the leveling plates of the breech ring, the line-of-fire arrow pointing toward the muzzle, and center the quadrant bubble by turning the elevating handwheel (fig. 59).

(3) Reverse the quadrant on the leveling plates (turn it end-for-end) (fig. 60). If the bubble recenters, the quadrant is in adjustment and the test is completed.

(4) If the bubble does not recenter, try to center it by turning the micrometer knob.

(*a*) If the bubble centers, read the black figures and divide by 2. This is the correction.

(*b*) Place the correction on the micrometer and level the tube by using the elevation handwheel.

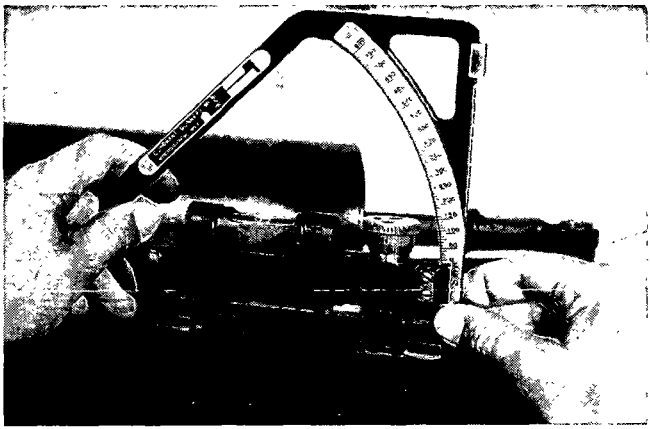

Figure 59. Leveling bubble of gunner's quadrant, normal position, end-for-end test.

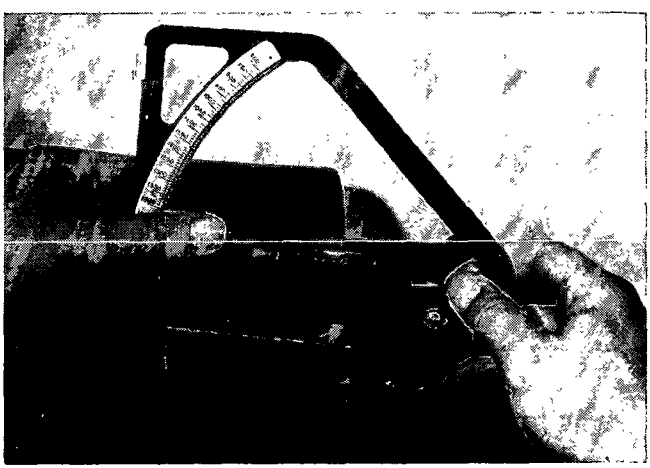

Figure 60. Centering bubble of gunner's quadrant, quadrant reversed.

(*c*) Check again by reversing the quadrant. The bubble should center.

(5) If the bubble does not center as in (4) above, move the arm down one graduation (10 mils).

(*a*) Turn the micrometer until the bubble centers.

(*b*) Take the reading on the micrometer, add 10 to it, and divide the sum by 2.

(*c*) Place this reading on the micrometer leaving the arms at minus 10; level the tube with the elevation handwheel.

(*d*) Check by reversing the quadrant on the seats. The bubble should center.

(*e*) Subtract the reading from 10. This is the correction.

(*f*) The quadrant should be sent to an ordnance unit if correction of error is more than plus or minus 0.4 mils.

c. Micrometer Test.

(1) Set the radial arm to read 10 mils on the elevation scale and set the micrometer at zero.

(2) Place the quadrant on the leveling plates on the breech ring, the line-of-fire arrow pointing toward the muzzle, and center the quadrant bubble by elevating the tube.

(3) Set the radial arm at zero on the elevation scale, and turn the micrometer one revolution to read 10 mils.

(4) Reseat the quadrant on the leveling plates. The bubble should center.

Caution: **Do not disturb the laying of the tube.**

(5) If the bubble does not center, the micrometer is in error and must be adjusted by ordnance personnel.

d. Comparison Test. Compare readings taken at low, medium, and high elevations with all the gunner's quadrants of a battery on the quadrant seats of a *single* piece. The trunnions of this piece should be level. Any quadrant differing from the average by more than 0.4 mil at any elevation should be sent to an ordnance unit for adjustment.

e. Correction. When a gunner's quadrant requires a correction as determined by the end-for-end test, this correction is not carried during firing but is applied only when making sight tests and adjustments.

60. Test of Azimuth Compensating Mechanism of Panoramic Telescope Mount

a. General. The purpose of this test is to determine whether the azimuth compensating mechanism of the telescope mount actually transmits the motion of the tube to the sight mount so that any deviation in deflection due to elevating the tube is corrected throughout all elevations. It checks the adjustment and mounting of the telescope mount, the setting of the cross-level and longitudinal-level vials, and the alinement of the telescope socket. The test in *b* below may be performed with the trunnions either level or canted. It reflects total errors of the entire mechanism. Because compensating errors of various parts of the mount may result in the weapon testing out properly with the test in *b* below, the other tests specified in *c* through *e* below should be performed regardless of the result of the test in *b*

below. Total errors found in the test in *b* below may then be reduced to errors in specific parts.

b. Test of Telescope Mount.

(1) With the boresights in place and the tube near zero elevation, traverse so that the line of sight through the tube is on the plumb line. Level the telescope mount in both directions by centering both the cross-level and longitudinal-level bubbles.

(2) Place the intersection of the crosslines of the panoramic telescope reticle on any sharply defined aiming point and note the deflection.

(3) Elevate the tube from zero to maximum elevation (or limit of the plumb line) in 100-mil steps. At each step, traverse the weapon (if necessary) to bring the line of sight through the tube back on the plumb line. (If the line of sight through the tube tracks the plumb line at all elevations, the trunnions are level. If it is necessary to traverse to bring the line of sight back to the plumb line, the trunnions are not level.) Relevel the telescope mount in both directions and check for deviation of the line of sight from the aiming point. If the vertical line is off the aiming point, it is turned to the aiming point with the azimuth micrometer knob and the deviation is measured on the azimuth micrometer. If the horizontal line of the reticle is off, it is brought to the aiming point with the leveling knobs and the bubble displacement is noted.

(4) If the vertical line deviates from the aiming point by more than ½-mil from the original deflection at any elevation tested or the correction for the deviation of the horizontal line causes either of the bubbles to travel in excess of ½-vial graduation, the telescope mount is out of adjustment or improperly mounted. The weapon must be referred to authorized ordnance maintenance personnel for adjustment or correction.

c. Telescope Mount Cross-Level Test.

(1) If the trunnions are not level, as noted in *b*(3) above, level them, using jacks if necessary, so that the line of sight through the tube tracks the plumb line at all elevations.

(2) Level the tube longitudinally with the gunner's quadrant.

(3) Center the cross-level bubble.

(4) Elevate the tube to maximum elevation keeping the sight mount longitudinal-level bubble level, noting the cross-level bubble.

(5) If the cross-level bubble does not remain centered within ½-vial graduation, either the telescope mount is misalined or the cross-level vial is incorrectly set. Refer the mount to authorized ordnance personnel for adjustment.

d. Telescope Mount Longitudinal-Level Test.

(1) Level the tube longitudinally with the gunner's quadrant.

(2) Center the longitudinal-level bubble.

(3) Operate the cross-leveling knob throughout the limits of motion; the longitudinal-level bubble should remain centered within ½-

vial graduation. If the bubble moves in excess of the tolerance, either the level vial or the actuating arm pivot is not alined correctly, and the weapon should be sent to an ordnance unit for adjustment.

e. Telescope Socket Alinement Test.

(1) Zero the panoramic telescope azimuth scale and micrometer.

(2) Traverse the tube to the right to place the vertical line of the telescope reticle on the plumb line in front of the piece. Level the mount bubbles.

(3) Sight through the telescope and rotate the telescope elevation knob through the extent of travel.

(4) If the intersection point on the reticle deviates from the plumb line by more than ½-mil, the telescope socket and mount are not correctly alined. Refer the mount to authorized ordnance personnel for correction.

61. Ordnance Check

It is not contemplated that using units will have the necessary facilities, tools, or skilled mechanics to perform the more precise tests and adjustments of sighting and fire control equipment. When deficiencies recur or when defects cannot be corrected in the field, ordnance checks should be scheduled.

62. Fuze Setters

a. General. Examine the stop which fits into the slot in the movable time ring and the adjusting pawl which engages the notch in the fixed fuze ring to see that their edges are not burred or bent. Depress

the adjustable pawl against its spring to see that the movement of the pawl is free. In the test in *b* below be sure to test the fuze setter with the fuze for which it is designed; the time scale on the fuze setter must have the same graduations as the time ring on the fuze.

b. Time Scale Test. Set the corrector to 30 and set any convenient time on the time scale. Test the time scale of the fuze setter by setting several fuzes.

Caution: **Before setting a fuze, make sure that the "T" and "C" screws of the fuze setter are tight to prevent any slipping of the scale indexes when the handle of the fuze setter is rotated. The time set on the fuze should agree with the time setting on the fuze setter within one-fourth of the smallest graduation on the fuze time ring. The tolerance amounts to 0.05 second for fuzes having 0.2-second graduations and 0.125 second for fuzes having 0.5-second graduations. If the fuzes set do not agree with the time set on the fuze setter, repeat the test as a check with a different setting. If the fuzes set still do not agree with the fuze setter, refer the instrument to an ordnance unit for adjustment.**

Caution: **Do not set any live fuze more than twice. The fuze from a dud must never be used. Reset all fuzes to SAFE and replace the safety wire or cotter pin.**

CHAPTER 8

MAINTENANCE AND INSPECTIONS

63. General

Maintenance and inspection are essential to insure that the section is prepared to carry out its mission immediately. Systematic maintenance and inspection drills provide the best insurance against unexpected breakdown at the critical moment when maximum performance is essential.

64. Disassembly, Adjustment, and Assembly

Disassemblies and adjustments of the weapon authorized to be performed by battery personnel are prescribed in TM 9–331A, supplemented by instructions contained in Department of the Army supply manuals. No deviation from these procedures is permitted unless authorized by the responsible ordnance officer.

65. Records

a. The principal records pertaining to the weapon are the Weapon Record Book (DA Form 9–13), a field report of accidents (AR 385–63), and the Unsatisfactory Equipment Report (DA Form 468). Information on the purpose and use of these records is shown on the forms.

b. The chiefs of sections, the battery executive, and the battery commander also should keep semipermanent records on their weapons for information and guidance.

66. Maintenance

For detailed instructions concerning maintenance of the 155-mm howitzer, see TM 9–331A and LO 9–331. For detailed instructions concerning maintenance of the vehicle used as a prime mover, see the technical manuals and lubrication orders pertaining to that vehicle.

67. Inspections

Regular inspections are required to insure that materiel is maintained in serviceable condition.

a. The chief of section is responsible for the equipment within his section. He should inspect it throughly each day. If he sees the need for repair or adjustment, he notifies the battery executive immediately so that the necessary action may be taken.

b. The executive, accompanied by the artillery mechanic, should make a daily spot check inspection. Each day he inspects different parts of the weapons to insure complete coverage every few days. At least once a month, the executive makes a thorough mechanical inspection of weapons, auxiliary equipment, tools, and spare parts.

c. Battery, battalion, and higher commanders should make frequent command inspections to assure themselves that the equipment in their commands is maintained at prescribed standards of condition, appearance, and completeness.

d. For details on inspecting the 155-mm howitzer, see TM 9–331A. For details on inspecting the vehicle used as a prime mover, see the appropriate technical manual for that vehicle. Deficiencies found during inspections should be corrected promptly.

e. Duties of individuals in performing the necessary inspections and maintenance of the howitzer are outlined in paragraphs 67 through 72. For further information, see paragraph 87. Work will be made routine, thorough, and rapid by following the drill outlined in this chapter. When the section is reduced in strength, the chief of section must reassign duties to insure that all maintenance steps are completed.

68. Duties in Inspection Before March

The inspection performed before operation is a final check on materiel prior to leaving the motor park for training in the field, before leaving the bivouac area for combat, or before displacement. After inspection and when all deficiencies have been corrected, the section is ready to go into action. Inspection duties of personnel are shown in table V.

Table V. Inspection Duties Before March

(Located in back of manual)

69. Duties in Inspection During March

The inspection performed during the march are constant checks on the operation of the materiel and the security of all the stowed equipment. There is no command for this inspection; it is carried on constantly. The responsibilities and duties of section personnel are as follows:

a. Chief of Section. The chief of section—

(1) Supervises march discipline.

(2) Assigns duties for air defense and antimechanized security.

b. Gunner. The gunner—

(1) Listens for abnormal or unusual noises, and,

when a truck is used as a prime mover, observes the towed load for security. He signals the chief of section in case of malfunction.

(2) Observes prime mover instruments and controls for proper functioning when a tractor is used as the prime mover.

c. Cannoneers. Cannoneers—

(1) Perform duties as air defense and antimechanized security sentries as assigned by the chief of section or the commander of the vehicle in which they are riding.

(2) Listen for abnormal or unusual noises indicatiing malfunction of the vehicle or howitzer.

(3) No. 7 observes towed load for security when a tractor is used as the prime mover. He signals the chief of section in case of malfunction.

d. Driver. The driver performs *during operation* duties as prescribed in the appropriate technical manual.

70. Duties in Inspection During the Halt

Inspection at the halt is made to insure that the howitzer and prime mover are in satisfactory operating condition. The halt provides an opportunity to inspect for malfunctions that cannot be detected during the march. The inspection is performed as soon as a halt is made. The chief of section, on being told the length of halt, will divide halt time between relief and maintenance. Inspection duties of personnel are shown in table VI.

Table VI. Inspection Duties During Halt

(Located in back of manual)

71. Inspection Duties Prior to and During Firing

Inspection before and during firing is a continuing inspection to insure proper functioning of materiel. No command is necessary; each member of the section performs appropriate inspections before and during firing as shown in *a* through *d* below.

a. Chief of Section. The chief of section—

(1) Supervises and commands the section as prescribed in chapters 4 and 5.

(2) Insures servicing of recoil system and testing and adjustment of sighting and fire control equipment prior to firing.

b. Gunner. The gunner—

(1) Tests and adjusts sighting and fire control equipment prior to firing, provided sufficient time is available.

(2) Performs inspection duties in firing as prescribed in chapters 4 and 5.

c. Cannoneers. Perform appropriate inspection as prescribed in chapters 4 and 5 and any other duties as directed by the chief of section.

d. Driver. The driver moves his vehicle to the motor park under the direction of the first sergeant and performs *after operation* inspection as prescribed in the appropriate technical manual.

72. Inspection Duties and Maintenance After Operation

After operation, the howitzer is immediately given whatever servicing and maintenance is needed to prepare it in every way for further sustained action or

to determine the need for maintenance by higher echelons. These operations may be performed in the motor park, bivouac area, or combat position. Inspection duties of personnel are shown in table VII.

Table VII. Inspection Duties and Maintenance After Operation

(Located in back of manual)

73. Duties in Weekly Inspection and Maintenance

In garrison, inspection and maintenance duties are performed weekly. On maneuver or in combat, they are performed after each field operation.

a. Chief of Section. The chief of section—

(1) Supervises the section in weekly inspection and maintenance of howitzer, tools, accessories, and equipment. See TM 9–331A and LO 9–331.

(2) Obtains assistance of the artillery mechanic for operations requiring skill and tools beyond the capabilities of the section.

b. Gunner, Assistant Gunner and Numbers 1 Through 6. The gunner, assistant gunner, and numbers 1 through 6 perform normal maintenance as directed by the chief of section.

c. Driver and Number 7. The driver and number 7, when directed by the chief of section, assist the motor mechanic in the performance of the prescribed vehicle inspection and maintenance.

CHAPTER 9

DECONTAMINATION OF EQUIPMENT

74. General

Equipment that has been contaminated by chemical, biological, or radiological agents constitutes a danger to personnel. *Contamination* means spreading of an injurious agent in any form and by any means. Persons, objects, or terrain may be contaminated. *Decontamination* is the process of making any contaminated place or object safe for unprotected personnel. This can be done by covering, removing, destroying, or changing into harmless substances the contaminating agent or agents. Generally, only equipment contaminated by persistent agents need be decontaminated.

75. Decontamination for Chemical Agents

a. Ammunition. With rags, wipe off visible contaminant from projectiles. Apply DANC (decontamination agent, noncorrosive, M4), wipe with gasoline-soaked rag, and then dry. If DANC is not available, scrub with soap and cool water. Slurry (equal weights of water and chloride of lime) can be used on contaminated ammunition containers, but it must not be allowed to penetrate into the ammunition.

b. Instruments. If exposed to corrosive gases, clean instruments as soon as possible with alcohol (or gasoline, if no alcohol is available), and apply

a thin coat of light machine oil. A rag dampened with DANC may be used, followed by drying with a clean rag and then applying a coat of machine oil. DANC injures plastic or hard rubber surfaces.

c. Weapons. Remove dirt, dust, grease, and oil. Do not apply wet mix but allow surfaces to air after soil and dirt have been removed. DANC can be used on all metal surfaces except the bore. Hot water, cleaning solvent, or repeated applications of gasoline on swabs are also effective on metal. If the emergency use is made of gasoline-soaked swabs (FM 21–40), extreme care must be taken to insure that the gasoline does not spread the contaminant and that no gasoline in liquid or vapor form remains which might be ignited when the howitzer is fired. After decontamination, weapons are dried and oiled.

d. Automotive Equipment. Light contamination from spray can be neutralized by exposure to air. For heavier contamination, use DANC on interior or exterior surfaces that personnel are likely to touch. For larger area decontamination, wash vehicle with water and scrub painted surfaces with soap and water.

76. Decontamination for Biological and Radiological Agents

a. General. After a contaminating attack, recovery of equipment may be achieved either by waiting, to permit the decay of contamination, or by active decontamination, to reduce danger to a level where it is no longer a significant hazard to operating personnel. Decontamination may be either rough or detailed, depending on the urgency of the mili-

tary situation. The procedure adopted will be a command decision.

b. Rough Decontamination. Rough decontamination is performed when urgency is the main factor. Its purpose is to reduce contamination sufficiently to permit personnel to work with, or close to, equipment for limited periods. Rough decontamination may be achieved by means of water or steam if available. Soap or other detergent used with water or steam aids in decontamination.

c. Detailed Decontamination. Detailed decontamination, in which the emphasis is on thoroughness, will be carried out in rear areas and repair bases and includes procedures of surface decontamination, aging and sealing, and disposal.

77. References

For further information on decontamination, see FM 21–40, TM 3–220, and TF 3–1407.

CHAPTER 10

DESTRUCTION OF EQUIPMENT

78. General

a. Tactical situations may arise in which it is necessary to abandon equipment in the combat zone. In such a situation, all abandoned equipment must be destroyed to prevent its use by the enemy.

b. The destruction of equipment subject to capture or abandonment in the combat zone will be undertaken only upon authority delegated by a division or higher commander.

c. All batteries must prepare plans for destroying their equipment in order to reduce the time required should destruction become necessary. The principles to be followed are as follows:

(1) Plans for destruction of equipment must be adequate, uniform, and easily carried out in the field.

(2) Destruction must be as complete as the available time, equipment, and personnel will permit. Since complete destruction requires considerable time, priorities must be established so that the more essential parts are destroyed first.

(3) The same essential parts must be destroyed on all like units to prevent the enemy from constructing a complete unit from damaged ones.

(4) Spare parts and accessories must be given

the same priorities as the parts installed on the equipment.

79. Methods

To destroy equipment adequately and uniformly, all personnel of the unit must know the plan and priority of destruction and be trained in the methods of destruction.

80. References

For detailed information on destruction of the 155-mm howitzer and fire control equipment, see TM 9–331A; for ammunition, see TM 9–1903. For destruction of the vehicle, see the technical manual appropriate to the vehicle used as the prime mover.

CHAPTER 11

SAFETY PRECAUTIONS

81. General

Safety precautions to be observed in training are prescribed in AR 385–63. Additional information is given in FM 6–40, TM 9–331A, and TM 9–1900. The more important safety precautions are summarized in this chapter.

82. Ammunition

a. All ammunition at the firing position must be so placed that it is protected against explosion in case of accident at the position. Flames and explosive materials, such as gasoline, must be kept away from the ammunition. Ammunition should be protected from direct rays of the sun by use of tarpaulin or other suitable covering.

b. Battery personnel must not attempt to disassemble fuzes.

c. If for any reason a round is not fired after the time fuze has been set, the fuze must be reset to SAFE before it is repackaged.

d. All rounds not fired which have been prepared for firing must be checked by the chief of section to insure that all powder increments are present in proper order and condition and that they are of the proper lot number. He also verifies that the lot number on the ammunition corresponds to the

lot number on the container. For ammunition that is to be returned to Ordnance, a battery officer must certify that ammunition has been properly reassembled. (For further details, see FM 6–40.)

83. Misfires

a. In the event of a misfire, make two more attempts to fire the piece.

***Caution:* The piece should remain as laid and all personnel must stay clear of the muzzle and path of recoil. Personnel not required for the operation should be cleared from the vicinity.**

b. If the primer is heard to fire, wait a minimum of 10 minutes before opening the breech. Remove the faulty charge, store separately from other charges, and dispose of with unused increments and igniter pads (TM 9–1903).

c. If the primer is not heard to fire, make two more attempts to fire and then proceed as follows:

(1) If the primer can be removed by assistant gunner, standing clear of the path of recoil, 2 minutes after the second attempt to fire, the primer may be removed and a new one inserted.

(2) If the primer cannot be removed safely as described above, no attempt will be made to open the breech or replace the primer for 10 minutes after the second attempt to fire has been made.

d. Handle misfire primers carefully and dispose of quickly because there is a possibility of primer hangfire.

84. Drill and Firing

a. The piece is kept unloaded except when firing is imminent.

b. Members of the howitzer section pass in rear of the piece when going from one side to another.

c. Personnel must stay a safe distance from the breech to prevent injury when the piece recoils.

d. During firing, personnel should use waste in their ears to protect eardrums against injury.

e. In training, there must always be a safety officer for each artillery unit firing. For duties of the safety officer, see FM 6–40.

CHAPTER 12

TRAINING

Section I. GENERAL

85. Purpose and Scope

The purpose of this chapter is to present the absolute minimum requirements for training the personnel of a howitzer section in the performance of their duties in service of the piece. It includes general information on the conduct of training, a minimum training schedule, and tests to be given for the qualification of gunners.

86. Objectives

The objectives are speed in training cannoneers in their individual duties; and, through drill, to weld them into an effective, coordinated team able to function efficiently in combat. During training, supervisors will keep in mind the proficiency sought by Army Training Tests (ATT) 6–116 and 6–117. Maximum efficiency is attained through continuous drills.

87. Conduct of Training

a. Training should be conducted in accordance with the principles given in FM 21–5. The goal of training should be the standards set forth in FM 6–125 and other pertinent Department of the Army publications.

b. In general, individual training is conducted by noncommissioned officers as far as practicable. Officers are responsible for training plans, for conducting unit training, and for supervising and testing individual training.

c. Throughout training, the application of prior instruction to current training must be emphasized.

d. A record of the training received by each individual in the section should be kept on a progress card by the chief of section. This card should show each period of instruction attended, tests taken, and remarks pertaining to progress. Progress cards should be inspected frequently by the battery executive to make sure that they are being kept properly and to determine the state of training. *Requiring the chief of section to keep these records emphasizes his responsibility toward his section.*

e. The necessity for developing leadership and initiative in noncommissioned officers must be emphasized constantly throughout training.

88. Standards To Be Attained

a. A satisfactorily trained howitzer section must be capable of performing the following functions in the time indicated:

(1) Firing 10 rounds (drill ammunition) at different deflections, quadrant, and time fuze settings, using the same charge, in 5.5 minutes by day and 6 minutes by night. Changes in data should be typical for an area time mission; data is announced from prepared cards.

(2) Performing after-firing care and maintenance of the howitzer. With the piece being

in position, clean and lubricate, disassemble and assemble the breech and firing mechanism, and inspect the weapon in 35 minutes by day and 45 minutes by night. All materials and tools required should be available at the position.

(3) Performing 6-month inspection and maintenance of the howitzer. With the piece prepared for action in the howitzer park, clean and lubricate, as authorized, all parts and assemblies and prepare for ordnance inspection in 2½ hours. All materials and tools required should be available in the howitzer park.

b. Each member of the howitzer section should know the duties of all other members of the section and be able to perform efficiently in all positions. See paragraphs 91 through 103 for tests to be given for the qualification of gunners.

Section II. MINIMUM TRAINING SCHEDULE

89. General

The training schedule outlined in paragraph 90 is a guide to meet the minimum training requirements for personnel of a howitzer section in subjects covered in this manual.

90. Individual Periods

a. Individual periods of training in service of the piece should be arranged, along with other battery training, into a balanced training program, taking into consideration the basic principles of training.

b. In general, except for service practice, periods

on any subject should not be longer than 1 hour. Periods of howitzer drill should be for only ½-hour and should be conducted in a vigorous manner.

c. Periods of howitzer drill should be preceded and followed by periods on subjects that are logically related to the drill. For example, a period of howitzer drill should be preceded by a period of testing and adjustment of sighting and fire control equipment and followed by a period on inspection and maintenance drills. A period on aiming post displacement correction may come between two periods of howitzer drill.

d. TM 9–331A provides information on which to base periods of instruction on description, characteristics, and functioning of the piece; familiarization with the piece, including breech and firing mechanisms, barrel assembly and slides, recoil mechanism, equilibrator, elevating mechanism, and sighting and fire control equipment; and field assembly and malfunction. These should be included in the battery training schedule, closely allied with the training in service of the piece outlined in paragraph 90. Approximately 8 hours should be devoted to this instruction.

e. Additional service of the piece training may be performed during battery training exercises.

91. Training Schedule (78 Hours)

Method	Hours	Subject	Text references	Training aids and equipment
C, D, PW_____	1	Organization and composition of howitzer section; general duties of individuals; formation of howitzer section.	Pars. 4–8 incl.	Howitzer and prime mover.
C, D, PW_____	1	Posts and posting of cannoneers; changing posts; mounting and dismounting.	Pars. 9–13, incl.	Do.
C, D, PW_____	2 (1-hour periods).	Coupling and uncoupling; prepare for action and march order; movement of piece by hand.	Pars. 14–19, incl.	Howitzer and prime mover.
C, D, PW_____	24 (½-hour periods).	Howitzer drill, duties in firing, indirect laying.	Pars. 20–29, incl; 40; 43–48 incl.	TOE equipment.

See note at end of table.

Method	Hours	Subject	Text references	Training aids and equipment
C, D, PW	9 (½-hour periods).	Howitzer drill, duties in firing, direct laying.	Pars. 30–39, incl.	Do.
C, D, PW	6 (1-hour and ½-hour periods).	Testing and adjusting of sighting and fire control equipment.	Pars. 49–61, incl.	Do.
C, D, PW	2 (½-hour periods).	Aiming post displacement correction.	Par. 41	TOE equipment, blackboard, and chalk.
C, D, PW	4 (1-hour periods).	Inspections and maintenance drills.	Pars. 62–72, incl.	TOE equipment.
C, D, PW	1	Decontamination of materiel	Pars. 73–76, incl.	Decontamination equipment and TOE equipment.

C, D, PW-----	1	Destruction of materiel to prevent use by the enemy.	Pars. 77–79, incl.	Demolition and TOE equipment.
C, D----------	1	Safety precautions----------	Pars. 80–83, incl.	TOE equipment.
PW----------	16 (4-hour periods).	Service practice, indirect laying.	Pars. 20–29, incl.; 40; 42–48, incl.	Do.
PW----------	4	Service practice, direct laying.	Pars. 30–39, incl.	Do.
C, PW--------	6 (1-hour periods).	Review and tests of subjects previously covered.	All previous references.	Do.

Note. C—conference, D—demonstration; PW—practical work.

Section III. TESTS FOR QUALIFICATION OF GUNNERS

92. Purpose and Scope

This section prescribes the tests to be given in the qualification of gunners. The purpose of the tests is to—

a. Provide a means of determining the relative proficiency of the individual artillery soldier in the performance of the duties of the gunner, 155-mm howitzer M1 and modifications. *The tests are not to be used as a basis for determining the relative proficiency of batteries or higher units.*

b. Serve as an adjunct to training.

93. General Instructions

a. Standards of Precision. The candidate will be required to perform the tests in accordance with the standards listed below:

(1) Scale settings must be exact and matching indexes must be brought into coincidence.

(2) Level bubbles must be exactly centered.

(3) The vertical line in the reticle of the panoramic telescope must be alined on the left edge of the aiming post or on exactly the same part of the aiming point or target each time the piece is laid.

(4) Final motions of azimuth and elevation setting knobs, as well as traversing and elevating handwheels, must be made in the appropriate direction. Final motion for setting scales is from the lower to the higher numbers. For elevation, the final motion of the handwheel should be in the

direction of the more difficult movement. Final motion for traversing is from left to right. Final movement of the vertical line of the telescope is from left to right.

b. Assistance. The candidate will receive no unauthorized assistance. Each candidate may select authorized assistants as indicated in the tests. If a candidate fails any test because of the fault of the examiner or any assistant, the test will be disregarded, and the candidate will be given another test of the same nature.

c. Time. The time for any test will be the time from the last word of the command to the last word of the candidate's report. The candidate may begin any test after the first word of the first command.

d. Scoring. Scoring will be conducted in accordance with the two subparagraphs *Penalties* and *Credit* under each subject. If a test is performed correctly, credit will be given in accordance with the subparagraph *Credit* under each subject. No credit will be allowed if conditions exist as specified in the subparagraphs titled *Penalties*. No penalty will be assessed in excess of the maximum credit for each test.

e. Preparation for Tests. The piece will be prepared for action and the candidate posted at the proper position corresponding to the test being conducted or as indicated in the subparagraphs entitled *Special Instructions*. The examiner will insure the candidate understands the requirements of each test and will require the candidate to report "I am ready," before each test.

f. Qualification Scores. Minimum scores required for qualification in the courses are as follows:

Individual classification	*Points*
Expert gunner	90
First-class gunner	80
Second-class gunner	70

94. Outline of tests

Paragraph No.	Subject	Number of tests	Points each	Maximum credit
94	Direct laying, panoramic telescope	4	2	8
95	Indirect laying, deflecting only	18	2	36
96	Laying for quadrant with elevation scale	3	2	6
97	Laying for quadrant with gunner's quadrant	3	2	6
98	Displacement correction	2		6
	Part I	(1)	5	(5)
	Part II	(1)	1	(1)
99	Measuring site to the mask	1	4	4
100	Measuring quadrant	1	4	4
101	Referring the piece	1	5	5
102	Test and adjustment of sighting and fire control equipment	6		10
	Test 1	(1)	2	(2)
	Tests 2, 3, 4, and 5	(4)	1	(4)
	Test 6	(1)	4	(4)
103	Materiel	3	5	15
	Total credit			100

95. Direct Laying, Panoramic Telescope

a. Scope of Tests.

(1) Four tests (two groups of two tests each) will be conducted in which the candidate will be required to execute commands similar to those given in *c* below.

(2) Tests 1 and 2 (and tests 3 and 4) will be executed as one series of commands.

(3) The candidate will be tested in the duties of the gunner.

b. Special Instructions.

(1) A stationary target will be placed approximately 600 meters from the piece.

(2) An assistant, selected by the candidate, will be posted to set the announced quadrant on the elevation scale and to keep the sight mount cross leveled.

(3) The candidate will be posted as the gunner.

(4) The piece will be pointed so that—

(*a*) A shift of approximately 100 mils will be required for tests 1 and 3.

(*b*) It will not be necessary to shift the trails for any of the four tests.

(5) Laying at the termination of tests 1 and 3 will not be disturbed prior to beginning tests 2 and 4.

(6) The examiner will announce the assumed direction of the movement of the target at the beginning of tests 1 and 3. The assumed direction of the movement of the target at test 3 will be opposite to that in test 1.

c. Outline of Tests.

Test Number	Examiner commands (for example)	Action of candidate
1 and 3	TARGET, THAT TANK; LEAD 5, QUADRANT 16.	Centers cross-level bubble. Traverses piece until proper lead has been set. Places horizontal line of reticle on the center of the visible mass of the target. When No. 3 calls "Ready" and No. 1 calls "Set," gives the command FIRE and steps clear.
2 and 4	RIGHT (LEFT) 4, ADD (DROP) 7.	Same as test No. 1 above.

d. Penalties. No credit will be allowed if, after each test—

(1) Azimuth scale has been moved from zero.
(2) The indexes on the azimuth micrometer have been moved from zero.
(3) The indexes on the rotating head of the panoramic telescope are not in coincidence.
(4) The lead in mils is not set properly.
(5) The horizontal reticle line is not on the center of the visible mass of the target.

e. Credit.

Time in seconds, exactly or less than	6	7	8
Credit	2.0	1.5	1.0

96. Indirect Laying, Deflection Only

a. Scope of Tests. Eighteen tests (two groups of nine tests each) will be conducted in which the candi-

date will be required to execute commands similar to those given in *c* below. Tests 1 through 9 (also tests 10 through 18) will be executed as one series of commands.

b. Special Instructions.

(1) Commands will not necessitate shifting trails.

(2) The examiner will select a suitable aiming point and identify it to the candidate.

(3) The command for new deflections for each test will be within the following prescribed limits:

Test number	Maximum change (mils)	Minimum change (mils)
2 and 11	180	140
3 and 12	90	70
4 and 13	40	20
6 and 15	260	210
7 and 16	100	60
8 and 17	50	30
9 and 18	20	10

(4) The piece will be laid with correct settings at the conclusion of each test before proceeding with the next test.

(5) Aiming posts will be set out at prescribed deflection and distances for these tests.

(6) The examiner will designate the section number of the piece to be used. The examiner will announce the deflection to be applied by the candidate.

c. Outline of Tests.

Test number	Examiner commands (for example)	Action of candidate
1 and 10	DEFLECTION 2490.	Sets deflection. Centers cross- and longitudinal-level bubbles. Traverses howitzer until vertical line is on left edge of aiming posts. Checks centering of bubbles. Relays if necessary. Calls "Ready" and steps clear.
2 and 11	DEFLECTION 2330.	Sets deflection. Lays on aiming posts. Checks centering of bubbles. Re-lays if necessary. Calls "Ready" and steps clear.
3 and 12	DEFLECTION 2405.	Same as test 2 above.
4 and 13	DEFLECTION 2430. At conclusion of test 4(13), give END OF MISSION (No time considered for this operation.)	Deflection 2430 opposite index. Same as test 2 above, but changes deflection to 2430.
5 and 14	AIMING POINT, CHURCH STEEPLE, REFER	Refers telescope to church steeple. Reads deflection and calls "No. 1, deflection (so much)."

Test number	Examiner commands (for example)	Action of candidate
6 and 15---	DEFLECTION 2400, REFER.	Slips the slipping azimuth micrometer scale to zero. Slips the slipping azimuth scale to 2400. Verifies that vertical reticle is on church steeple. Calls "No. 1, deflection 2400." Steps clear.
7 and 16---	DEFLECTION 2485.	Same as test 1 above.
8 and 17---	DEFLECTION 2495.	Same as test 2 above.
9 and 18---	DEFLECTION 2410.	Same as test 2 above.

d. Penalties.

(1) No credit will be allowed if, after each test—

(*a*) The deflection is set incorrectly.

(*b*) The cross-level or longitudinal-level bubble is not centered.

(*c*) The vertical line of the telescope is not on the aiming point or left edge of aiming posts.

(2) No credit will be allowed if the last motion of the traverse was not made from left to right.

e. Credit.

Time in seconds, exactly or less than—			
Tests 1, 10, 6, and 15, each	13	14	15
Other tests, each	8	9	10
Credit	2.0	1.5	1.0

97. Laying for Quadrant With Elevation Scale

a. Scope of Tests. Three tests will be conducted in which the candidate will be required to execute commands similar to those given in *c* below.

b. Special Instructions.

(1) The quadrant setting on the elevation scale prior to test 1 will be within 40 mils of the initial quadrant for the test.

(2) Each test will require a change of settings and the accompanying laying of the tube in quadrant within the limits of 20 to 40 mils.

(3) Commands for quadrant for tests 2 and 3 will not be made in the multiples of 5 mils.

c. Outline of Tests.

Test number	Examiner commands (for example)	Action of candidate
1	QUADRANT 420_ _	Sets announced quadrant. Centers eross-level and longitudinal-level bubbles. Calls "Ready" and steps clear.
2	QUADRANT 446_ _	Same as test 1 above.
3	QUADRANT 479_ _	Same as test 1 above.

d. Penalties.

(1) No credit will be allowed if, after each test—

(*a*) The quadrant is set incorrectly.

(*b*) The cross-level or longitudinal-level bubble is not centered.

(2) No credit will be allowed if the last movement of the elevating handwheel was not made in the direction in which it is more difficult to turn.

c. Credit.

Time in seconds, exactly or less than	4	5⅔	6⅓
Credit	2.0	1.5	1.0

98. Laying for Quadrant With Gunner's Quadrant

a. Scope of Tests. Three tests will be conducted in which the candidate will be required to execute commands similar to those given in *c* below.

b. Special Instructions.

(1) The gunner's quadrant will be set at zero for the first test.

(2) Each succeeding test will require a change of quadrant setting within the limits of 30 to 60 mils.

(3) The candidate will be posted to the left of the left wheel and facing the sight mount with the gunner's quadrant in his hand.

(4) An assistant, selected by the candidate, will be posted to the left of the breech to operate the elevating handwheel.

c. Outline of Tests.

Test number	Examiner commands (for example)	Action of candidate
1_____	QUADRANT 180__	Sets quadrant on gunner's quadrant. Places quadrant on seat on sight mount. Has assistant elevate or depress the tube until the quadrant bubble is centered. Calls "Ready" and waits for examiner to verify laying.
2_____	QUADRANT 240__	Same as test 1 above.
3_____	QUADRANT 205__	Same as test 1 above.

d. Penalties.

(1) No credit will be allowed if, after each test—

(*a*) The quadrant is set incorrectly.

(*b*) The quadrant is not properly seated.

(*c*) The quadrant bubble is not properly centered.

(2) No credit will be allowed if the last movement of the tube was not in the direction in which it is more difficult to turn the elevating handwheel.

e. Credit.

Time in seconds, exactly or less than---	8	8⅔	9
Credit ----------	2.0	1.5	1.0

99. Displacement Correction

a. Scope of Test. One test, consisting of two parts, will be conducted in which the candidate will be required to execute the commands given in *c* below.

b. Special Instructions.

(1) Aiming posts will be set out at the prescribed distances.

(2) An assistant, selected by the candidate, will be stationed close to the far aiming post.

(3) The examiner will require the candidate to lay the piece on an announced deflection and report "I am ready."

(4) The far post or the piece will then be moved so that a displacement of 5 to 10 mils occurs.

cy 2

FM 6–81
*C 3

CHANGE
No. 3

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *23 November 1964*

FIELD MANUAL

155–MM HOWITZER, M114 TOWED

FM 6–81, 28 March 1962 is changed as follows:
Change title of manual to read as above.

* * * * *

22. Gunner

a. The gunner—

* * * * *

(2) Lays the piece for direction.
(3) (Superseded) Lays the piece for quadrant.
(4) Alines the * * * by number 5.

* * * * *

b. Detailed Description of Duties.

* * * * *

(10) *Calling "Ready."* After the piece has been laid and **the assistant gunner** has called "SET," the gunner verifies the laying, moves his head clear of the telescope, and calls "Ready" to indicate that the piece is ready to be fired.

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*This change supersedes C 2, 26 July 1963.

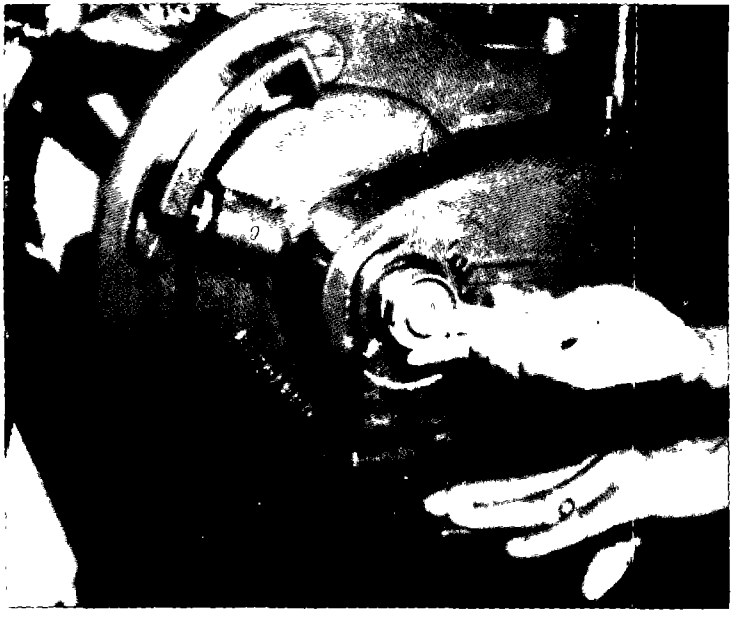

Figure 23. (Superseded) *Seating the firing mechanism.*

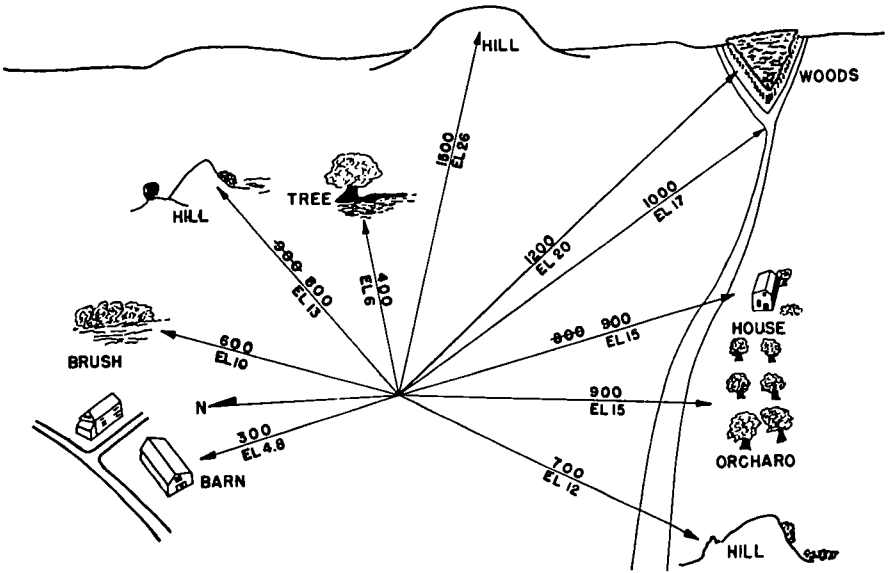

Figure 30. (Superseded) *Range card for direct laying.*

28. Number 5

* * * * *

b. Detailed Description of Duties.

(1) *Prepares powder charges.*

(*a*) *Type M3 (green bag).* The M3 (green bag) * * * with this charge (TM 9–1300–205). When firing charges 3 and 4, the M3 (green bag) propelling charge is preferred over use of the M4A1 (white bag) propelling charge.

(*b*) *Type M4 (white bag).* (As rescinded by C 1, 21 Dec 62)

(*c*) *Type M4A1 (white bag).* (As rescinded by C 2, 26 Jul 63)

Table II. Prepare for Action. Sequence 15, No. 6 and No. 7, add: **Dig recoil pit.***

Note.* **To prevent serious damage to the trails of the howitzer when firing the XM454 projectile the howitzer will be modified to provide long recoil regardless of angle of elevation of the weapon. This will require a recoil pit to be dug approximately 20 inches in depth to prevent the breech from striking the ground when the variable recoil mechanism has been disconnected. When firing the XM154 projectile, traverse is limited to 178 mils left and right of center.

By Order of the Secretary of the Army:

HAROLD K. JOHNSON,
General, United States Army,
Chief of Staff.

Official:
J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

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6-115 (2)
6-118 (2)
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NG: State AG (3); Units—same as Active Army except allowance is two (2) copies to each unit.

USAR: Units—same as Active Army except allowance is one copy to each unit.

For explanation of abbrevations used, see AR 320-50.

U.S GOVERNMENT PRINTING OFFICE:1964

FM 6–81
C 4

CHANGE No. 4

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *28 June 1968*

155-MM HOWITZER, M114, TOWED

FM 6–81, 28 March 1962, is changed as follows:

Page 9, paragraph 5. After subparagraph *e* the following is added.

Note. The duties of personnel for the M123A1, 155-mm howitzer are the same as for the M114A1 except in prepare for action and march order where they vary only slightly. See TM 9–1025–200–12 for detailed information regarding the auxiliary power system when spreading or closing the trails and removing the caster wheel.

Page 10, paragraph 7*b*. In lines 7 and 8 "CEASE FIRING" is changed to read "CHECK FIRING."

Page 26. Paragraph 20*d* is superseded as follows:

d. No. 1 swabs the powder chamber, inspects and announces the condition of the bore after each round and assisted by No. 4 rams the projectile.

Page 30, paragraph 21*b*(3). In line 1 "*Measuring site to the mask*" is changed to read "*Measuring site to crest.*"

Page 30, paragraph 21*b*(3)(*a*). In lines 1 and 2 "MEASURE THE SITE TO MASK" is changed to read "MEASURE THE SITE TO THE CREST."

Page 34. Paragraph 22*a*(4) is superseded as follows:

(4) Aline the aiming posts or collimator, assisted by number 4.

Page 39. Paragraph 22*b*(4) is superseded as follows:

(4) *Alines the aiming posts or collimator.* With the piece laid as in (2) above, the gunner sets the panoramic telescope at the battery common deflection, normally 2400 and, with hand signals directs the number 4 in alining the post with the vertical line of the reticle of the sight (fig. 18) (para 41*c*). If because of the nature of the terrain, the post cannot be set out at deflection 2400, the gunner turns the azimuth micrometer knob until the nonslipping azimuth scale is on another even hundred mil graduation. He alines the posts at this new deflection. The chief of the section reports the altered deflection to the executive "No. (so-and-so) aiming posts at (so many hundred), deflection 2400 in lake (or other reason)." The executive will then command NUMBER (so-and-so), DEFLECTION 2400, REFER. At this command, the gunner loosens the slipping azimuth scale locking screw and moves the slipping azimuth scale to deflection 2400 (fig. 19). He then tightens the locking screw and verifies the adjustment. If the collimator is used, the gunner illuminates the reticle on the collimator and directs number 4 in alining the 0 line of the collimator with the vertical reticle of the panoramic telescope.

Page 53. Paragraph 24*b*(3) is superseded as follows:

(3) *When two or more rounds are fired, calls out the number of the round and the announced quadrant.* When two or more rounds are to be fired, number 1 calls out the number of the round and the quadrant as he finishes ramming the projectile. As

he finishes ramming the last round, he adds, "Last round." For example when two rounds are to be fired at quadrant 480, he calls out, "Second and last round, 480." He should not speak louder than is necessary to insure being heard by the members of his own section.

Page 63, paragraph 27*b*. Subparagraph (4) is added as follows:

(4) *Sets out the collimator (aiming posts if required) when so directed.* For a detailed description, see paragraph 22*b*(4).

Page 66. Paragraph 28*b*(4) is rescinded.

Page 68. Paragraph 31*a*.1 is added as follows:

a.1 Central laying is the type of laying used. It is preferred over reticle laying. Both are discussed in paragraphs 35 through 40.

Page 70, paragraph 34*a*(1). In line 1, "*Ranges from 0 to 400 meters.*" is changed to read "*Ranges up to 600 meters.*"

Pages 70 and 71, paragraph 34*a*. Subparagraphs (2) and (3) are superseded as follows:

(2) *Ranges from 600 to 1,500 meters.* When firing within these ranges, bracket adjustment of the target is required; 200-meter range changes should be made until a bracket is obtained.

(3) *Ranges over 1,500 meters.* At these ranges, adjustment of the target is also required, however, 400-meter range changes should be made until a bracket is obtained.

Page 71, paragraph 34*a*(4). In line 1, and in line 2 "over 2,500 meters" is changed to read "over 2,300 meters."

Page 72. Table IV is superseded as follows:

Table IV. Trajectory Characteristics, Shell HE, Charge 7

(Meters)	Elevation	Vertical Displacement (Feet)	Trajectory Characteristics	Firing Data
100	1.6	0.5	Within these ranges, the trajectory will be flat enough to prevent an 8-foot tank from passing under it. A 400-meter range is ideal for opening fire on the target.	Start firing using a 400-meter range setting.
200	3.2	1.0		
300	4.8	1.5		
400	6.4	1.5		
500	8.1	2.0		
600	9.8	3.0	Within these ranges, bracket adjustment on the target is required. 200-meter range changes should be made until a bracket is obtained.	1. Start firing using the estimated range at the closest 100-meter range. 2. Adjustment on the target by bracketing (overs and shorts) is required.
700	11.5	3.5		
800	13.2	4.0		
900	14.9	4.5		
1,000	16.7	5.0		
1,100	18.5	5.5		

1,200	20.3	6.0		3. Make 200-meter range changes until a bracket is obtained.
1,300	22.1	6.5		
1,400	23.9	7.0		
1,500	25.8	8.0	Within these ranges, bracket adjustment on the target s also required. 400-meter range changes should be made until a bracket is obtained.	1. Start firing using the estimated range at the closest 100-meter range. 2. Adjustment on the target by bracketing (overs and shorts) s required. 3. Make 400-meter range changes until a bracket is obtained.
1,600	27.7	8.5		
1,700	29.6	9.5		
1,800	31.5	10.5		
1,900	33.5	11.0		
2,000	35.5	12.0		
2,100	37.6	12.5		
2,200	39.6	13.0		
2,300	41.6	13.5		

Page 77. Paragraph 36 is superseded as follows:

36. Gunner

a. Duties. The gunner—central laying.

(1) Centers the cross-level bubble on the panoramic telescope mount initially.

(2) Places the announced lead on the azimuth micrometer scale.

(3) Tracks the target with the traversing handwheel and places the vertical line of the reticle directly on the target.

(4) Commands FIRE, provided number 2 has called "Ready."

(5) Re-lays on the target and follows subsequent commands.

b. Duties. The gunner—

(1) Centers the cross-level bubble on the panoramic telescope mount initially.

(2) Sets the azimuth scales of the panoramic telescope at zero.

(3) Lays on the target with the announced lead.

(4) Tracks the target with the traversing handwheel.

(5) Commands FIRE, provided number 2 has called "Ready."

(6) Re-lays on the target.

(7) Follows subsequent commands.

c. Detailed Description of Certain Duties.

(1) Lays on the target with the announced lead and tracks the target.

(*a*) Prior to any direct fire mission, the gunner verifies that the movable azimuth micrometer (gunner's aid) index is set at zero.

(*b*) If the slipping azimuth and slipping micrometer scales have not been slipped, the gunner zeros these two scales.

(*c*) If only the slipping azimuth scale has been slipped, the gunner disregards this scale. He opens the door over the nonslipping azimuth scale and sets that scale at zero. The micrometer scale is brought to zero.

(*d*) If both the slipping micrometer scale and the slipping azimuth scale have been slipped, the gunner opens the azimuth scale door and turns the nonslipping azimuth scale to zero. He then turns the azimuth micrometer knob until the left index of the micrometer matches the right index.

(*e*) The operations described above make the line of sight of the telescope parallel to the axis of the bore. The gunner then tracks the target using the traversing handwheel, keeping the vertical line of the panoramic telescope ahead of the target by measuring the announced lead on the reticle scale (reticle laying), or keeps the vertical line on the center of the target after the lead has been set off on the panoramic telescope (central laying). If time does not permit the chief of section to announce the lead, it is estimated by the gunner.

(2) Commands FIRE. After AG and No. 2 call "Set" and "Ready," respectively, and when ready, the gunner commands FIRE.

Page 79. Figure 31, the caption is changed to read "*Gunner's sight picture, reticle laying, (lead 15 mils).*"

Page 82, paragraph 42. The title is changed to read "Aiming Points and Collimator Displacement Cor-

rections," and in line 2 "referred to the aiming posts and," is changed to read "referred to the collimator (or aiming posts) and."

Page 85. Paragraph 42*e* is added as follows:

e. Collimator. The infinity-aiming reference collimator (fig. 33.1) is an optical instrument which simulates an azimuth reference target at infinity. The collimator is alined with the vertical reticle of the panoramic telescope as directed by the gunner.

(1) The collimator is emplaced in any convenient position, from 4 to 15 meters to the left side of the weapon. Best results are obtained from 5 to 11 meters.

(2) While the howitzer is being laid, number 5 alines the optical system of the collimator on the center of the telescope rotating head and cross-levels the reticle pattern.

(3) After the howitzer is laid the gunner directs number 4 in alining the 0 line of the collimator reticle with the vertical reticle of the panoramic telescope.

Page 86. Figure 33.1 is added as follows:

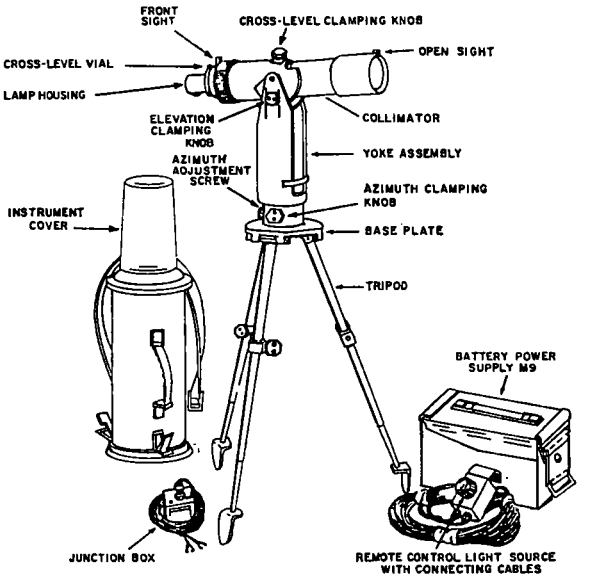
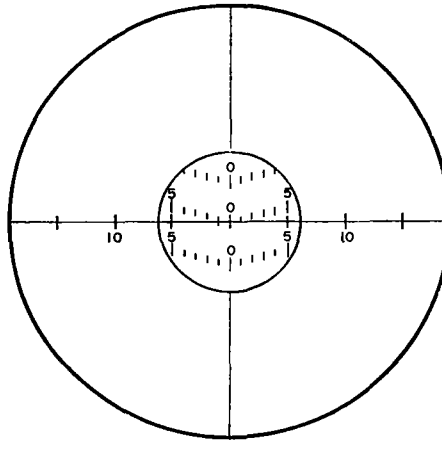
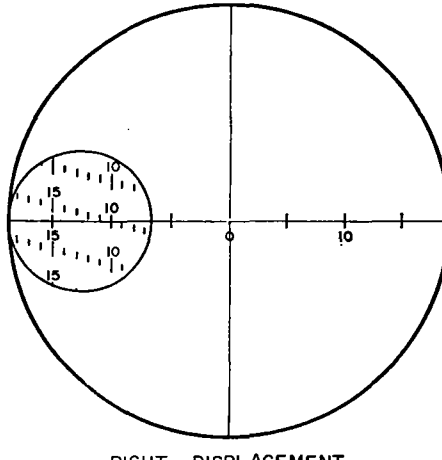


Figure 33.1. Infinity-aiming reference collimator and auxiliary equipment.

Page 86. Figure 33.2 is added as follows:

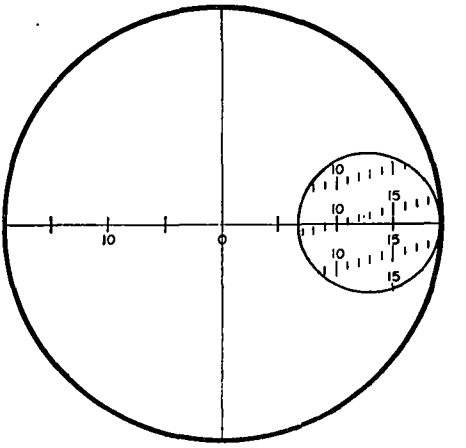


INITIAL ALIGNMENT



RIGHT DISPLACEMENT

Figure 33.2. Gunner's sight picture of collimator when correcting for displacement.



LEFT DISPLACEMENT

Figure 33.2—Continued.

(4) To lay for direction during firing, the gunner sets the announced deflection on the panoramic telescope and alines any number on the panoramic telescope reticle with the same number in the appropriate direction (fig. 33.2) on the collimator reticle. This procedure for laying compensates for weapon displacement during firing.

Note. For positive location, an area at least 7 mils in diameter must be seen at all times on the collimator reticle.

Page 89. Paragraph 45 is superseded as follows:

45. Check Firing

The command CHECK FIRING normally is given to the howitzer section by the chief of section, but in emergencies anyone present may give the command. At this command, regardless of source, firing ceases

immediately. If the piece is loaded, the chief of section reports that fact to the executive. The executive acknowledges this report by saying "No. (so-and-so) loaded." If CHECK FIRING came from the fire direction center, firing is resumed at the command, CANCEL CHECK FIRING, QUADRANT (so much). If CHECK FIRING came from the fire direction center, firing is resumed at the announcement of the quadrant. If CHECK FIRING came from within the firing battery, the executive will investigate the condition that caused the command to be given. When the condition has been corrected, firing is resumed by the executives command of CANCEL CHECK FIRING followed by quadrant.

Page 91, paragraph 46*b*. In line 2 "CEASE FIRE" is changed to read "CHECK FIRE."

Page 95, paragraph 51*b*. In line 4, "2,500" is changed to read "1,500."

Page 109, paragraph 55. In line 5, "2,500" is changed to read "1,500."

Page 138, paragraph 67*b*. In lines 1 and 2 "artillery mechanic" is changed to read "the chief of firing battery."

Page 148. Paragraph 81 is superseded as follows:

81. General

Safety precautions to be observed in training are prescribed in AR 385–63. Additional information is given in FM 6–40 and TM 9–1900. The more important safety precautions are summarized in this chapter. General precautions always observed in drill and firing are as follows:

a. The piece is kept unloaded except when firing is imminent.

b. Members of the howitzer section pass in rear of the piece when going from one side to another.

c. Personnel must stay a safe distance from the breech to prevent injury when the piece recoils.

d. During firing, personnel should use earplugs in their ears to protect eardrums against injury.

e. In training there must always be a safety officer for each artillery unit firing. For duties of the safety officer, see FM 6–40.

Page 150. Paragraph 84 is superseded as follows:

84. Explosive Rounds in Hot Tubes

Explosive projectiles in heated tubes present an extremely hazardous situation. High rates of fire for extended period with high charges necessitate the following precautions be observed:

a. Do not chamber the round in a weapon until immediately prior to firing.

b. A round that has been chambered in a weapon should be fired or removed from the weapon within 5 minutes.

c. If the round in a heated tube cannot be fired or removed within the 5-minute period, the following actions should be taken:

(1) Where a misfire *is not* involved and in the event the round cannot be fired or removed within 5 minutes, the primer and propelling charge should be removed immediately, then elevate the cannon tube approximately 30° and evacuate all personnel to safe distance. Allow the projectile and weapon to cool for 2 hours.

(2) After a 2-hour waiting period proceed as follows. Move the weapon carefully or relocate to a remote position. If relocating is necessary the cannon

tube should be lowered and locked in the traveling position. Waste will be placed in the chamber to cushion the projectile and to protect the face of the breechblock while the weapon is being moved. Request assistance from EOD personnel or request Direct Support Maintenance personnel with technical advice of EOD personnel regarding recognition of possible exuded explosive or other hazards to carefully remove the cannon tube (with stuck projectile) at a remote location away from buildings and occupied areas. The cannon tube containing the stuck projectile should then be released to EOD personnel.

(3) For separate loading ammunition involved in a misfire:

(*a*) Wait for 2 minutes from the last attempt to fire before removing the primer. If the primer has fired, personnel should be evacuated to a safe distance for a 2-hour waiting period without removing the propelling charge. After the 2-hour waiting period remove the propelling charge and follow the guidance outlined in (2) above.

(*b*) If the primer has not fired after the 2-minute waiting period a new primer will be tried or the faulty firing mechanism corrected. Then should the weapon not fire within a total elapsed time of 5 minutes, the propelling charge will be removed and personnel should be evacuated to a safe distance for a 2-hour waiting period. The guidance outlined in (2) above should then be followed.

Page 151, paragraph 86. In line 6, "(ATT) 6–116 and 6–117" is changed to read "(ATT) 6–157 and Army Training Program (ATP) 6–100."

Page 152, paragraph 87*d*. In lines 6 and 7, "the battery executive to make" is changed to read "the battery executive and chief of firing battery to make."

Page 156, paragraph 91. In the third item under "Subject" "Aiming post displacement" is changed to read "Aiming post or collimator displacement" and under Text references "Par. 41" is changed to read "Para 41 and 42."

Page 168, paragraph 99*b*(1). In line 1 "Aiming posts will" is changed to read "Aiming posts or collimator will" and in *b*(2) "or collimator" is added to the end of the sentence.

Page 169, paragraph 99*c*(1). In the Action of candidate column, line 4 is changed to read "telescope, or has correct sight picture on the collimator." In *c*(2) in the Examiner commands column line 2 is changed to read "POSTS OR COLLIMATOR."

Page 169, paragraph 99*d*(1)(*a*). In line 4 after "telescope" the following is added "or sight picture is not correct on the collimator."

Page 170. Paragraph 99*d*(2)(*c*) is superseded as follows:

(*c*) The vertical line of the telescope is not on the left edge of the aiming posts or correct sight picture does not appear in the collimator.

Pages 182–184. The following references are deleted from the appendix:

ATT 6–5
ATT 6–117
DA Pam 310–29
FM 6–20
FM 6–21

FM 25–10
LO 9–331
TF 3–1407
TOE 6–118D
TM 5–505
TM 9–331A
TM 9–575
TM 9–2300
TM 9–2810
TM 9–8028

The following publications are added to the appendix:

ATT 6–157	Field Artillery Howitzer Battery, Light or Medium, Towed or Self-Propelled.
FM 6–20–1	Field Artillery Tactics.
FM 6–20–2	Field Artillery Techniques.
FM 55–35	Motor Transport Operations and Motor Transport Units.
LO 9–1025–200–10	Howitzer, Medium, Towed, 155-mm, M114 and M114A1 and Howitzer Medium, Towed. Auxillary Propelled, 155-mm, M123A1.
TF 3–2871	Decontaminating Procedures for Toxic Chemical Agents.
TOE 6–167	Field Artillery Battery, 155-mm, Towed Field Artillery Battalion, Infantry Division.

TM 9–1025–200–12	Operator and Organizational Maintenance Manual, Howitzer Medium, Towed 155-mm M114 and M114A1, and Howitzer, Medium Towed, Auxillary Propelled 155-mm M123A1.
TM 38–750	Army Equipment Record Procedures.

Table II, foldin. In sequence 12, column No. 5 is superseded as follows:

Assembles the aiming posts or collimator and sets them (it) out when so directed by chief of section.

In sequence 15 columns No. 6 and No. 7 the following is added:

"Dig recoil pit."

Table III, foldin. In sequence 1, column No. 4 is superseded as follows:

Recovers, disassembles, and stows the collimator (aiming posts, if required).

Table V, foldin. In sequence 4, column No. 4 is superseded as follows:

Verifies the presence and completeness of the collimator (aiming posts and aiming posts lights, if required).

Table VI, foldin. In sequence 1, Gunner column line 4 "aiming posts" is changed to read "collimator (aiming posts)."

Table VII, foldin. In sequence 1, column 4, is superseded as follows:

Maintains the collimator (aiming posts and post lights).

By Order of the Secretary of the Army:

HAROLD K. JOHNSON,
General, United States Army,
Chief of Staff.

Official:

KENNETH G. WICKHAM,
Major General, United States Army,
The Adjutant General.

Distribution:

To be distributed in accordance with DA Form 12–11 requirements for 155 MM Howitzer, M114, Towed.

(5) The laying of the piece at the termination of part I will not be disturbed before beginning part II.

c. Outline of Test.

(1) *Part I.*

Examiner commands	Action of candidate
CORRECT FOR DISPLACEMENT.	Lays the piece so that the far post appears midway between the near post and the vertical line of the telescope. Checks centering of bubbles. Re-lays if necessary. Calls "Ready" and steps clear.

(2) *Part II.*

Examiner commands	Action of candidate
ALINE AIMING POSTS.	Directs assistant in alining aiming posts. Calls "Ready" and steps clear.

d. Penalties. No credit will be allowed if—

(1) *Part I.*

(*a*) The far aiming post does not appear midway between the near post and the vertical line of the telescope.

(*b*) The cross-level or longitudinal-level bubble is not centered.

(*c*) The last motion of traverse was not made from left to right.

(2) *Part II.*

(*a*) The deflection is other than the announced deflection.

(*b*) The aiming posts are not properly alined.

(*c*) The vertical line of the telescope is not on the left edge of the aiming posts.

c. Credit.

(1) *Part I.*

Time in seconds, exactly or less than	3	3⅓	3⅔	4
Credit	5.0	4.0	3.0	2.0

(2) *Part II.*

No time limit.

Credit	1.0	--	--	--

100. Measuring Site to Mask

a. Scope of Test. One test will be conducted in which the candidate will be required to execute the command given in *c* below.

b. Special Instructions.

(1) The piece prepared for action will be placed 200 to 400 meters from a mask of reasonable height.

(2) The tube will be pointed so that it is 100 to 150 mils above the crest and 100 to 150 mils right or left of the highest point of the crest.

(3) The candidate will take post at the right rear of the breech.

(4) An assistant, selected by the candidate, will be stationed at the post of the gunner to operate the elevating and traversing mechanism.

c. Outline of Test.

Examiner commands	Action of candidate
MEASURE SITE TO MASK	Sights along lowest element of bore and has his assistant operate elevating and traversing mechanism until line of sight just clears crest. Centers longitudinal-level bubble by turning elevating knob, and centers cross-level bubble. Reads elevation from elevation scale and micrometer. Reports "No. (so-and-so), site to mask (so much)."

d. Penalties. No credit will be allowed if—

(1) The line of sight along the lowest element of the bore does not just clear crest.

(2) The cross-level or longitudinal-level bubble is not centered.

(3) The site is announced incorrectly.

(4) The last movement of the tube was not in the direction in which it is more difficult to turn the elevating handwheel.

e. Credit.

Time in seconds, exactly or less than	14	15	16	17
Credit	4.0	3.0	2.0	1.5

101. Measuring Quadrant

a. Scope of Test. One test will be conducted in which the candidate will be required to measure the quadrant by means of the gunner's quadrant.

b. Special Instructions. Prior to the test, the examiner will lay the tube at a selected quadrant, measure the quadrant, and then set the gunner's quadrant at zero.

c. Outline of Test.

Examiner commands	Action of candidate
MEASURE THE QUADRANT.	Places gunner's quadrant on quadrant seats of the sight mount. Levels bubble by raising or lowering the index arm and turning the micrometer knob. Announces "No. (so-and-so), quadrant (so much)," and hands quadrant to examiner.

d. Penalties. No credit will be allowed if—

(1) The quadrant bubble is not centered when the quadrant is seated properly.

(2) The quadrant is announced incorrectly.

e. Credit.

Time in seconds, exactly or less than	8	9⅔	10⅗
Credit	4.0	3.0	2.0

102. Referring the Piece

a. Scope of Test. One test will be conducted in which the candidate will be required to measure and report a deflection in accordance with the command given in *c* below.

b. Special Instructions.

(1) The piece will be laid on aiming posts to the left front.

(2) An aiming point within 200 mils to the left or right of the aiming posts will be designated by the examiner and identified by the candidate.

c. Outline of Test.

Examiner commands	Action of candidate
NUMBER (so-and-so), AIMING POINT, THAT (so-and-so), REFER.	Centers cross-level and longitudinal-level bubbles. Refers to aiming point. Checks centering of bubbles and relays telescope if necessary. Reads deflection and reports, "No. (so-and-so), deflection (so much)" and steps clear.

d. Penalties. No credit will be allowed if—

(1) The cross-level or longitudinal-level bubble is not centered.

(2) The vertical line of the telescope is not on the aiming point.

(3) The deflection is announced incorrectly.

(4) The traversing handwheel is turned.

e. Credit.

Time in seconds, exactly or less than	5	5⅗	6	6⅗
Credit	5.0	4.0	3.0	2.5

103. Test and Adjustment of Sighting and Fire Control Equipment

a. Scope of Tests. Six tests will be conducted in which the candidate will be required to demonstrate

the methods employed in making the prescribed tests and authorized adjustments or to describe the action taken (i.e., send to the ordnance maintenance company) if adjustment is not authorized to be made by using personnel.

b. Special Instructions.

(1) The piece will be prepared for the tests as indicated in paragraph 53*a*.

(2) The equipment that will be needed for the tests includes boresights, testing target, and gunner's quadrant.

(3) The candidate will select an assistant who will operate the elevating handwheel at the direction of the candidate during tests 1 and 2 and adjust and aline the testing target at the direction of the candidate prior to test 6.

(4) The tests will be conducted in the sequence indicated in *c* below. After completion of test 2, the gunner's quadrant used in tests 1 and 2 will be used for tests 3 and 4 with the proper correction, as determined in test 1, carried on the quadrant. If the correction exceeds 0.4 mil, a different quadrant will be used.

(5) Adjustment which the candidate may be required to accomplish will fall within the following limits:

(*a*) Elevation scale telescope mount, not to exceed one 100-mil graduation.

(*b*) Elevation micrometer scale telescope mount, not to exceed ten 1-mil graduations.

(*c*) Rotating head elevation index, panoramic telescope, none.

(*d*) Rotating head elevation micrometer index, panoramic telescope, not to exceed one-fourth turn.

(*e*) Panoramic telescope slipping azimuth micrometer scale, not to exceed ten 1-mil graduations.

(*f*) Actuating arm pivot, not to exceed 10 mils out of alinement with base.

(6) The tube will be leveled at the conclusion of test 3 and will not be disturbed thereafter.

c. Outline of Tests.

Test number	Examiner commands	Action of candidate
1	PERFORM END-FOR-END TEST ON GUNNER'S QUADRANT.	Performs test as prescribed in paragraph 58*b*. Calls "Error (so many) mils, quadrant serviceable (unserviceable)" and hands quadrant to examiner for verification.
2	PERFORM MICROMETER TEST ON GUNNER'S QUADRANT.	Performs test as prescribed in paragraph 58*c*. Calls "Quadrant micrometer is (is not) in error."
3	TEST ACTUATING ARM PIVOT.	Performs test and makes adjustment, if necessary, as prescribed in paragraph 53*a*(3).

Test number	Examiner commands	Action of candidate
4	TEST LEVELS ON TELESCOPE MOUNT.	Performs tests and makes adjustments, if necessary, as prescribed in paragraph 59. Calls "Cross-(Longitudinal-) level bubble(s) within (without) allowable limit." ***Caution:* Do not turn cross-leveling or elevation knobs of the telescope mount after this test.**
5	TEST ELEVATION SCALE AND MICROMETER.	Performs tests and makes adjustments, if necessary, as prescribed in paragraph 53. Calls "Ready" and steps clear. *Note.* Prior to test 6, the cross- and longitudinal-leveling of the tube and the panoramic telescope mount will be verified by the examiner, and the testing target will be alined by the candidate with the help of his selected assistant as described in paragraph 53.
6	BORESIGHT THE PIECE.	Performs tests and makes adjustments as described in paragraph 53. Calls "Ready" and steps clear.

d. Penalties.

(1) *General.* The tests are not essentially speed tests. The purpose of the prescribed time limits is to insure that the candidate can perform the operation without wasted effort.

(2) *Test 1.* No credit will be allowed if—

(*a*) The bubble of the gunner's quadrant does not center when verified by the examiner.

(*b*) The necessary correction (one-half of the amount of the angle, which was indicated when the quadrant was first reversed and the bubble centered by moving the index arm and micrometer) is announced incorrectly by the candidate.

(*c*) The candidate fails to declare the quadrant unserviceable if the necessary correction exceeds 0.4 mil or fails to declare the quadrant serviceable if the necessary correction is 0.4 mil or less.

(*d*) The time to complete the test exceeds 2 minutes.

(3) *Test 2.* No credit will be allowed if—

(*a*) The procedure is not followed correctly.

(*b*) The time to complete the test exceeds 1 minute.

(4) *Test 3.* No credit will be allowed if—

(*a*) The bubble of the gunner's quadrant is not centered in either direction.

(*b*) The candidate announces incorrectly the status of either the cross-level or the longitudinal-level bubble.

(*c*) The time to complete the test and adjustments exceeds 1 minute.

(5) *Test 4.* No credit will be allowed if—

(*a*) The procedure was not followed correctly.

(*b*) The time to complete the test and adjustments exceeds 3 minutes.

(6) *Test 5.* No credit will be allowed if—

(*a*) The elevation micrometer does not read

zero when the elevation scale reads zero.

(*b*) The cross-level or longitudinal-level bubble is not centered.

(*c*) The time to complete the test and adjustments exceeds 2 minutes.

(7) *Test 6.* No credit will be allowed if—

(*a*) The candidate fails to make any adjustment when such adjustment is indicated.

(*b*) The rotating head elevation micrometer indexes are not in coincidence.

(*c*) The zero line of either the azimuth scale or azimuth scale micrometer is not in coincidence with its respective index.

(*d*) The center line of the bore, as viewed through the boresights, or the line of sight of the telescope does not fall on their respective sighting points on the testing target when all scales are set at zero.

(*e*) The time to complete the tests and adjustments exceeds 4 minutes 30 seconds.

e. Credit.

(1) The candidate will be scored on the general merit of his work in addition to the specific requirements above.

(2) If the tests and adjustments are performed correctly within the prescribed time limit, maximum credit will be given as follows:

Test 1	2
Test 2	1
Test 3	1
Test 4	1
Test 5	1
Test 6	4
Total	10

104. Materiel

a. Scope of Tests. The candidate will be required to perform three tests as outlined in *c* below.

b. Special Instructions.

(1) *Tests 1 and 2.* For tests 1 and 2, a paulin will be placed on the ground for the convenience of the candidate in laying out the disassembled parts. The candidate will be allowed to select the tools and accessories necessary for the performance of the tests prior to the start of the tests. The candidate may select an assistant to aid him in lowering and lifting the breechblock.

(2) *Test 3.*

(*a*) A complete set of lubrication equipment authorized for use of battery personnel will be made conveniently available on a paulin adjacent to the piece.

(*b*) Every type of lubricant used on the piece will be placed in plainly labeled containers conveniently on the paulin.

c. Outline of Tests.

Test number	Examiner commands	Action of candidate
1	DISASSEMBLE BREECH AND FIRING MECHANISMS.	Performs the operation as deseribed in TM 9–331A, laying the parts on the paulin. After disassembly, identifies all parts to examiner.
2	ASSEMBLE BREECH AND FIRING MECHANISMS.	Performs the operation as described in TM 9–331A.

Test number	Examiner commands	Action of candidate
3------	PERFORM DAILY, WEEKLY, AND MONTHLY LUBRICATION TEST.	Selects proper lubricating equipment and lubricant and tells *how*, *when*, and with *which lubricant* each lubrication point is serviced. (Actual lubrication is not performed.)

d. Penalties.

(1) The tests are not essentially speed tests. The purpose of the maximum time limits is to insure that the candidate can perform the operations without wasted effort.

(2) No credit will be given if the following time limits are exceeded:

	Minutes
Test 1	8
Test 2	12
Test 3	5

(3) A penalty of one-half point will be assessed for each component part not correctly identified or omitted in test 1. There is no time limit imposed on the identification of component parts. However, the examiner may reduce the grade if it becomes obvious that the candidate is not familiar with the nomenclature.

(4) A penalty of one-half point will be assessed for each lubrication point missed or lubricated improperly and for each time the proper lubricating device or proper lubricant is not selected.

e. Credit.

(1) The candidate will be scored on the general merit of his work in addition to the specific requirements above.

(2) A maximum credit of five points will be given for each test which is performed correctly within the prescribed time limit.

APPENDIX

REFERENCES

AR 320–5	Dictionary of United States Army Terms.
AR 320–50	Authorized Abbreviations and Brevity Codes.
AR 385–40	Accident Reporting and Records.
AR 385–63	Regulations for Firing Ammunition of Training, Target Practice, and Combat.
AR 672–5–1	Awards.
AR 611–201	Manual of Enlisted Military Occupational Specialties.
AR 750–5	Organization, Policies, and Responsibilities for Maintenance Operation.
ATT 6–5	Light and Medium Field Artillery Battalions.
ATT 6–117	Field Artillery Howitzer Battery, 105–mm or 155–mm.
DA Pam 108–1	Index of Army Motion Pictures, Film Strips, Slides, and Phono-Recordings.
DA Pam 310-series	Military Publications.
DA Pam 310–29	Index of Supply Manuals, Ordnance Corps.
FM 5–15	Field Fortifications.
FM 5–20	Camouflage, Basic Principles and Field Camouflage.
FM 5–25	Explosives and Demolitions.
FM 6–20	Field Artillery Tactics and Techniques.
FM 6–21	Division Artillery.
FM 6–40	Field Artillery Cannon Gunnery.

FM 6–125	Qualification Tests for Specialists, Field Artillery.
FM 6–135	Adjustment of Artillery Fire by the Combat Soldier.
FM 6–140	The Field Artillery Battery.
FM 21–5	Military Training.
FM 21–30	Military Symbols.
FM 21–40	Small Unit Procedures in Nuclear, Biological, and Chemical Warfare.
FM 22–5	Drill and Ceremonies.
FM 23–65	Browning Machinegun, Caliber .50 HB, M2.
FM 25–10	Motor Transportation, Operations.
LO 9–331	Howitzer, 155-mm, M1; carriage. Howitzer, 155-mm, M1A1, M1A2.
TF 3–1407	Decontamination Procedures.
TOE 6–118D	Infantry Division Field Artillery Howitzer Battery, 155-mm, Towed.
TOE 6–427D	Field Artillery Howitzer Battery, 155-mm, Towed or Self-Propelled.
TM 3–220	Chemical, Biological, and Radiological Decontamination.
TM 5–505	Maintenance of Engineer Equipment.
TM 9–331A	155-mm Howitzer M1 and 155-mm Howitzer Carriages M1A1 and M1A2.
TM 9–575	Auxiliary Sighting and Fire Control Equipment.
TM 9–786	13-ton High Speed Tractors M5, M5A1, M5A2, and M5A3.
TM 9–1527	Ordnance Maintenance: Gunner's Quadrants M1 and M1918 and Machinegun Clinometer M1917.
TM 9–1545	Ordnance Maintenance: Telescope Mounts, and Range and Elevation Quadrants for Motor Carriages, Field Artillery and Antiaircraft Artillery.
TM 9–1590	Fuze Setters M14, M22, M23, M25, and M27.

TM 9–1900	Ammunition, General.
TM 9–1300–205	Ammunition for Mortars.
TM 9–2300	Artillery Material and Associated Equipment.
TM 9–2810	Tactical Motor Vehicle Preventive Maintenance, Supply, Inspection, and Training Procedures.
TM 9–238	Preparation of Ordnance Material for Deep Water Fording.
TM 9–6111	Panoramic Telescopes.
TM 9–802S	Operational and Organizational Maintenance, 5-ton, 6x6, Cargo Truck M41 and M54.
TM 21–300	Driver Selection and Training (Wheeled Vehicles).
TM 21–301	Driver Selection, Training, and Supervision Full-track Vehicles.
TM 21–305	Manual for the Wheeled Vehicle Driver.
TM 21–306	Manual for the Full-track Vehicle Driver.
FT 155–Q–3	Firing Tables for Cannon, 155-mm Howitzer, M1.

INDEX

	Paragraphs	Page
Action:		
Front	15	22
Left	15	22
Right	15	22
Prepare for	17	23
Adjustment, disassembly and assembly	64	137
Adjustment of sighting and fire control:		
Equipment	51–62	95
Qualification tests	103	173
To verify	21	27
Agents, biological, procedures for decontaminating	70	140
Agents, chemical, procedures for decontaminating	75	143
Agents, radiological, procedures for decontaminating	76	144
Aiming Circle method, boresighting	56	110
Aiming point	21, 22	27, 34
Aiming point, distant	42, 55	82, 109
Aiming points and displacement corrections	42	82
Aiming Posts:		
Aline	22	34
Correction for displacement	42, 99	82, 168
Lights	42	82
Set out	27	62
Ammunition (*see also* Rounds):		
Care of	48	93
Decontamination procedure	75	143
Effects of various	34	70
Safety precautions	81–84	148
Selection	34	70
To remove from containers	28, 48	63, 93
To replace	48, 82	93, 148
Trajectories	34	70
Angle, standard, method of boresighting	57	123
Announced lead, to lay on target with	36	77

	Paragraphs	Page
Appendix, references		182
Assembly, disassembly, and adjustment	64	137
Assign duties with reduced personnel	21	27
Assistance, gunner's qualification tests	93	158
Assistant Gunner, duties:		
General	5	8
In direct laying	37	79
In indirect laying	23	46
In inspection and maintenance:		
After operation	72	141
Before march	68	139
During halt	70	140
During march	69	139
Prior to and during firing	71	141
Weekly	73	142
Automotive equipment, decontaminating	75	143
Azimuth alinement	60	132
Azimuth compensating mechanism of telescope mount, test	60	132
Basic data, to record	21	27
Basic periodic tests	58–62	127
Battery (definition)	2	3
Biological agents, procedures in decontaminating	76	144
Board, section data	49	94
Bore and chamber, to inspect	24	51
Bore, to swab	24	51
Breech:		
To inspect when open	24	51
To open and close	23	46
Breechlock, to clean and oil	23	46
Bubbles, telescope mount, to center	22	34
Call off	8	11
Cannoneers (*see also* No. 9 and Section drill)	5	8
Posts	9	12
To post	9	12
Card, range, preparation	32	68
Care and maintenance	63–73	137
Care of ammunition	48	93
Cease firing	45	89

	Paragraphs	Page
Center bubbles	22	34
Chamber, to inspect	24	51
Change:		
A deflection	22	34
Fuze of projectiles	25	55
In lead	35	75
In range	35	75
Changes in data during firing	46	91
Charges:		
Selection of, for trajectory	34	70
To place in chamber	26	60
To prepare	28	63
To replace unused	48, 82	93, 148
Check functioning of materiel	21	27
Chemical agents, decontaminating procedures	75	143
Chief of section, duties:		
General	5, 67	8, 138
In firing direct laying	35	75
In firing indirect laying	21	27
In inspection and maintenance	67	138
After operation	72	141
Before operation	68	139
During halt	70	140
During march	69	139
Prior to and during firing	71	141
Weekly	73	142
Circle, aiming, method of boresighting	56	110
Classification, individual, gunner's qualification test	92, 93	158
"Close," to call	26	60
Combination time and superquick fuzes	25	55
Command:		
Initial, to give	35	75
Subsequent, to give	35	75
To fire	21	27
Common aiming point, to set deflection on	22	34
Comparison test	59	129
Compensating meshanism, azimuth, test	60	132
Composition, howitzer section	4	8

	Paragraphs	Page
Conduct:		
Fire of piece	35	75
Prearranged fires	21	27
Conduct of:		
Fire	34	70
Training	87	151
Corporal, ammunition. (*See* Ammunition corporal.)		
Correction(s):		
Gunner's quadrant	59	129
Correction, displacement:		
And aiming points	42	82
For aiming posts	42	82
Qualification tests	99	168
Couple	19	24
Coupled (definition)	2	3
Cross-level test:		
Of telescope mount	60	132
Data, basic, to record	21	27
Data board, section	49	94
Data, changes	46	91
Definitions and terms	2, 74	3, 143
Deflection:		
Common, to set	22	34
Qualification tests:		
Indirect laying	96	162
To set or change	22	34
Designation of target	35	75
Direction:		
Of fire	15	22
To lay for	22	34
Disassembly, adjustment, and assembly of weapon	64	137
Dismount	12	20
Displacement:		
Aiming post, to make correction	22	34
Corrections:		
And aiming points	42	82
For aiming posts	42	82
Qualification tests	99	168
Table, vertical	34	70

	Paragraphs	Page
Distance, from pieces to aiming post, to measure	42	82
Distant aiming point	42	82
Method of boresighting	55	109
Drill:		
Safety precautions	84	150
Section, objectives	6	10
Driver, duties:		
General	5	8
In inspection and maintenance:		
After operation	72	141
Before operation	68	139
During halt	70	140
During march	69	139
Prior to and during firing	71	141
Weekly	73	142
Duties, to assign to reduced personnel	21	27
Duties:		
Coupling	19	24
Firing, direct laying	35–40	75
Firing, indirect laying	20–34	26
Inspection and maintenance (entire section):		
After operation	72	141
Before march	68	139
During halt	70	140
During march	69	139
Prior to and during firing	71	141
Weekly	73	142
Movement of gun by hand	16	23
Personnel	5	8
Preparation for action	17	23
Preparation for travel	18	24
Reassignment	40	80
Uncoupling	14	21
Effects of various ammunition	34	70
Elevation:		
Call out announced	24	51
Lay for	21	27
Lay for, with quadrant	21	27

	Paragraphs	Page
Elevation—Continued		
Measure	21	27
Set	21, 38	27, 80
Elevation, tests and adjustment:		
Micrometer index	54	102
Scales	54	102
Emplacement of howitzer, preparation	43	86
End-for-end test	59	129
Equipment:		
Automotive, procedures for decontaminating	75	143
Boresighting	51	95
Sighting. (*See* Sighting and fire control equipment.)		
Errors. (*See* Mistakes.)		
Estimate range to target	35	75
Executive, battery:		
Inspections	67	138
Fall in	8	11
Fall out	13	20
Field of fire	33	68
Fire:		
Conduct	34	70
Direction, to lay	22	34
Field	33	68
Method	34	70
To command	21, 36	27, 77
To conduct	34	70
To indicate piece ready	21	27
The piece	23	46
To the front	15	22
To the flank	15	22
Fire commands, to follow	21	27
Fire control and sighting equipment. (*See* Sighting.)		
Fires, prearranged, to conduct	21	27
Firing:		
Cease	45, 46	89, 91
Changes in data during	46	91
Duties in. (*See* Duties.)		
With reduced personnel	21	27

	Paragraphs	Page
Firing and drill, safety precautions	84	150
Firing mechanism, to clean	23	46
Firing position, placing	14, 17	21, 23
Flank, to fire	15	22
Form the section	8	11
Front (definition)	2	3
Front, to fire	15	22
Functioning of materiel, to observe and check	21	27
Fuze to set:		
Quick, superquick, and delay	25	55
Time and superquick	25	55
Time using fuze setter	25	55
VT	25	55
Fuze or change fuze of projectile	25	55
Fuze, to remove	25	55
Fuze setter:		
M26	25	55
Setting fuzes with	25	55
M27	25	55
Setting fuzes with	25	55
M28	25	55
Setting fuzes with	25	55
To set	25	55
Tests	62	135
Give commands:		
Initial	35	75
Subsequent, based on effect	35	75
Gunner duties:		
General	5	8
In firing:		
Direct laying	36	77
Indirect laying	22	34
Inspection and maintenance:		
After operation	72	141
Before march	68	139
During halt	70	140
During the march	69	139
Prior to and during firing	71	141
Weekly	73	142

	Paragraphs	Page
Gunner's quadrant:		
Test:		
Comparison	59	129
End-for-end	59	129
Micrometer	59	129
Use:		
Qualification test, laying with	98	167
To lay for elevation with	21	27
To level trunnions	52	97
Gunner's qualification test. (*See* Tests.)		
Halt, duties in inspection during	70	140
Hand, movement of piece	16	23
Howitzer. (*See* Materiel.)		
Howitzer (*see also* Materiel):		
Definition	2	3
Movement by hand	16	23
Placing in firing position	14, 17	21, 23
Placing in travel position (march order)	18	24
Preparation for emplacement of	43	86
To conduct fire of	35	75
To fire	23	46
To indicate when ready to fire	21	27
To lay for direction	22	34
To load	24, 27, 28, 29	51, 62, 63, 66
To prime	23	46
To refer	22	34
To unload	47	91
Howitzer section, composition	4	8
Howitzer uncoupled, coupled, section formation	9	12
Identify the target	35	75
In battery (definition)	2	3
Incidents, unusual, to report	21	27
Increments	82	148
Individual:		
Duties	20	26
Qualification tests:		
Classification	93	153
Training	90	153

	Paragraphs	Page
Inspect the chamber and bore	24	51
Inspection and maintenance	63–73	137
After operation	72	141
Before march	68	139
During halt	70	140
During march	69	139
Prior to and during firing	71	141
Weekly	73	142
Instructions, section drill	6	10
Instruments, procedures for decontaminating	75	143
Jacking	17	23
Lay:		
For elevation	21, 22	27, 34
For direction	22	34
On the target	36	77
Laying:		
For direction	22	34
Direct (*see also* Duties)	31–40	67
Indirect (*see also* Duties)	20–30	26
Precision	41	82
Qualification tests:		
Deflection only	96	162
For quadrant with gunner's quadrant	78	146
For quadrant with elevation scale	97	166
Lead	35	75
Change in	35	75
To determine	35	75
To lay with	36	77
Left (definition)	2	3
Level the bubbles	22	34
Level trunnions. (*See* Trunnions.)		
Light, aiming post	42	82
List of duties. (*See* Duties.)		
Load the piece	24, 26, 27, 29	51, 60, 62, 66
March, inspection during	69	139
March order	18	24

63153S—62——13

	Paragraphs	Page
Mask, to measure site	21	27
Qualification test	100	170
Materiel:		
Care and maintenance	66, 67	138
Destruction	78	146
Observe functioning	21	27
Qualification tests	104	179
Measure:		
Elevation	21	27
Qualification tests	101	171
Site to mask	21	27
Qualification tests	100	170
Mechanism, firing to clean	23	46
Method of fire	35	75
Methods:		
Boresighting	52	97
Aiming circle	56	110
Distant aiming point	55	109
Equipment	51	95
Standard angle	57	123
Testing target	54	102
Destruction of equipment	79	147
Micrometer test	59	129
Mil scale on testing target	44	87
Minimum training schedule	89, 91	153, 155
Misfires, safety precautions	83	149
Mistakes, report	21	27
Mount, telescope:		
Cross-level test	60	132
To center bubbles	22	34
Mount	11	16
Movement of howitzer by hand	16	23
No. 1 cannoneer, duties:		
General	5	8
In direct laying	35	75
In indirect laying	24	51
Inspection and maintenance:		
After operation	72	141
Before march	68	139

	Paragraphs	Page
No. 1 cannoneer duties—Continued		
Inspection and maintenance—Continued		
During halt	70	140
During march	69	139
Prior to and during firing	71	141
Weekly	73	142
No. 2 cannoneer, duties:		
General	5	8
In direct laying	39	80
In indirect laying	25	55
In inspection and maintenance:		
After operation	72	141
Before march	68	139
During halt	70	140
During march	69	139
Prior to and during firing	71	141
Weekly	73	142
No. 3 cannoneer, duties:		
General	5	8
In direct laying	39	80
In indirect laying	26	60
In inspection and maintenance:		
After operation	72	141
Before march	68	139
During halt	70	140
During march	69	139
Prior to and during firing	71	141
Weekly	73	142
No. 4 cannoneer, duties:		
General	5	8
In direct laying	39	80
In indirect laying	27	62
In inspection and maintenance:		
After operation	72	141
Before march	68	139
During halt	70	140
During march	69	139
Prior to and during firing	71	141
Weekly	73	142

	Paragraphs	Page
No. 5 cannoneer, duties:		
General	5	8
In direct laying	39	80
In indirect laying	28	63
In inspection and maintenance:		
After operation	72	141
Before march	68	139
During halt	70	140
During march	69	139
Prior to and during firing	71	141
Weekly	73	142
No. 6 cannoneer, duties:		
General	5	8
In direct laying	39	80
In indirect laying	29	66
In inspection and maintenance:		
After operation	72	141
Before march	68	139
During halt	70	140
During march	69	139
Prior to and during firing	71	141
Weekly	73	142
No. 7 cannoneer, duties:		
General	5	8
In direct laying	39	80
In indirect laying	30	66
In inspection and maintenance:		
After operation	72	141
Before march	68	139
During halt	70	140
During march	69	139
Prior to and during firing	71	141
Weekly	73	142
Objective:		
Section drill	6	10
Training	86	151
Outline, qualification tests	94	160

	Paragraphs	Page
Panoramic telescope:		
Care and maintenance	68, 71, 72	139, 141
Direct laying	36	77
Qualification tests	95	161
Indirect laying	22	34
Qualification tests	96	162
Tests and adjustment	54	102
Panoramic telescope mount, test	60	132
Parallax	56	110
Periodic tests, basic	58	127
Periods, individual training	90	153
Personnel:		
General duties	5	8
To assign duties when reduced	21	27
Pits:		
Recoil	43	86
Spade	43	86
Placing howitzer in position:		
Firing	14, 17	21, 23
Traveling (march order)	18	24
Preparation	43	86
Plumb line	51	95
Point, aiming:		
To indicate to gunner	21	27
To set a common deflection on	22	34
Point, aiming, distant	42	82
Method of boresighting	55	109
Points, aiming and displacement corrections	42	82
Position, emplacement of howitzer, preparation	43	86
Posts, aiming	42	82
Correction for displacement	42	82
Qualification tests	99	168
To make	22	34
To aline	22	34
To set out	27	62

	Paragraphs	Page
Posts of:		
Cannoneers	9	12
Piece coupled	9	12
Piece uncoupled	9	12
Piece prepared for action	9	12
To change	10	16
Powder charge. (*See* Charge.)		
Prearranged fires, to conduct	21	27
Precision:		
In laying	41	82
Standards, qualification tests	93	158
Preliminary commands and formations	8	11
Preparation:		
For gunner's qualification tests	93	158
Of a range card	33	68
Of position	43	86
Prepare:		
Charges	28	63
For action	17	23
For travel	18	24
To dismount	12	20
To mount	11	16
Preparing charges, to assist in	28	63
Prime, to, the piece	23	46
Prime movers:		
Care and maintenance	67, 68, 72, 73	138, 139, 141, 142
To uncouple	14	21
Primer vent, to clean	23	46
Procedures for decontamination	75, 76	143, 144
Projectile:		
Carry	26, 29	60, 66
Fuze	25	55
Ram	24	51
Unload	47	91
Purpose and scope:		
Gunner's qualification tests	92	158
Manual	1	3

	Paragraphs	Page
Quadrant, gunner's. (*See* Gunner's quadrant.)		
Quadrant, qualification tests:		
Laying for, with:		
Elevation scale	97	166
Gunner's quadrant	98	167
Measuring	101	171
Quadrant, range. (*See* Range quadrant.)		
Qualification of gunners. (*See* Tests.)		
Qualification scores	93	158
Radiological agents, procedures, in decontaminating	76	144
Ram, to, the projectile	24	51
Rammer:		
Unload with	45	89
Use	24	51
Range	35	75
Change	35	75
Selection for trajectory	34	70
To estimate to target	35	75
Range card	32	68
"Ready," to call	22, 38	34, 80
Recoil pits	43	86
Record basic data	21	27
Records	65	137
Reduced personnel, to assign duties	21	27
Refer the piece	22	34
Qualification test	102	172
Reference lines on testing target	44	87
Remainder of section, duties	39	80
Remove ammunition from containers	48	93
Replace:		
Ammunition, unused	82	148
Increments	82	148
Report mistakes	21	27
Responsibilities in maintenance:		
Battery and higher commanders	67	138
Chief of section	67	138
Executive	67	138
Right (definition)	2	3

	Paragraphs	Page
Rounds (*see also* Ammunition):		
Replace increments	82	148
To call out number	24	51
Scale, mil, on testing target	44	87
Scales, test and adjustment:		
Elevation micrometer index	54	102
Time	62	135
Schedule, minimum training	89–91	153
Scope, purpose	1	3
Scores, qualification tests	93	158
Section data board	49	94
Select the target	35	75
Set:		
Deflection	22	34
Fuzes	25	55
Fuze setter	25	55
Quadrant	22	34
"Set," to call	23	46
Set out aiming posts	27	62
Setters, fuze. (*See* Fuze setters.)		
Sighting and fire control equipment:		
Boresighting	51	95
Care and maintenance	68–71	139
Decontamination	75	143
Tests and adjustments	50, 62	95, 135
To verify adjustment	21	27
Qualification tests	103	173
Site, to mask	21	27
Qualification tests	100	170
Spade pits	43	86
Standard angle method of boresighting	57	123
Standards:		
Of precision	93	158
To be attained	88	152
Subsequent commands, based on effect	35	75
Superquick and time fuzes	25	55
Swab bore	24	51
System, direct laying	41	82
Table, displacement, vertical	34	70

	Paragraphs	Page
Target:		
Designation	35	75
Testing	44, 54	87, 102
To identify or select	35	75
To estimate range	35	75
To lay on and track	36	77
Types, selection for direct laying	34	70
Target, testing. (*See* Testing target.)		
Telescope, panoramic. (*See* Panoramic telescope.)		
Telescope mount:		
Test	60	132
To center bubbles	22	34
Terms and definitions	2	3
Testing target	44	87
Testing target method	54	102
Tests:		
Elevating mechanism	54	102
End-for-end	59	129
Fuze setter	62	135
Gunner's quadrant	59	129
Micrometer	54	102
Panoramic telescope	54	102
Panoramic telescope mount	60	132
Tests for qualification of gunners:		
Direct laying:		
Panoramic telescope	95	161
Displacement correction	99	168
Laying for elevation with:		
Elevation scale	97	166
Gunner's quadrant	98	167
Materiel	104	179
Measuring (*also see* Referring):		
Quadrant	101	171
Site to mask	100	170
Sighting and fire control equipment	103	173
Time, qualification tests	93	158
Time and superquick fuzes	25	55
Time fuzes, setting	25	55
Time scale test	62	135

	Paragraphs	Page
Track the target	36	77
Trail shifting	16	23
Training:		
Conduct	87	151
Individual periods	90	153
Objectives	86	151
Standards to be obtained	88	152
Trajectories	39	80
Trunnions:		
Boresighting	52	97
Testing telescope mount	60	132
To level	52	97
Uncouple	14	21
Uncoupled:		
Definition	2	3
Posts and section formation	9	12
Unload the piece	47	91
Use the rammer	47	91
Vent, primer, to clean	23	46
Vertical displacement table	34	70
Vertical reference lines on testing target	44	87
VT fuzes	25	55
Weapons, decontaminating	75	143
Weekly inspection and maintenance, duties	73	142

BY ORDER OF THE SECRETARY OF THE ARMY:

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The Adjutant General.

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ACSI (2)	Corps (3)
DCSOPS (2)	Div (2)
DCSLOG (2)	Inf Bde (1)
ACSRC (1)	Div Arty (5)
Tech Stf. DA (1)	FA Gp (2)
CRD (1)	FA Bn (1) except TOE's 6–115, 6–135, 6–165, 6–355 (10)
CINFO (1)	FA Btry (1) except TOE's 6–11S, 6–137, 6–167, 6–357 (20); 6–501 (3)
TIG (1)	USMA (50)
MDW (5)	USAAMS (1,070)
ARADCOM (2)	
Seventh US Army (5)	
EUSA (5)	

NG: State AG (3).; TOE units 6–100, 6–115 (3); 6–116, 6–11S, 6–401 (2); 6–425 (3); 6–426, 6–427, 6–501, 7–1, 17–1 (2).

USAR: TOE units Div (2): Div Arty (5); FA Gp (2); FA Bn (1) except TOE's 6–115, 6–135 (10); FA Btry (1) except TOE's 6–11S, 6–137 (20): 6–501 (3).

For explanation of abbreviations used, see AR 320–50.

U. S. GOVERNMENT PRINTING OFFICE: 1962

Table I. Duties in Uncoupling

Sequence	Chief of Section	Gunner	AG	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7
1	Supervises all members of the section throughout all sections.	Set respective handbrakes.		Take positions at trail handles as shown in figure 9.		Take positions at trail handles as shown in figure 9.			Closes service cut-out cock on prime mover (fig. 10); disconnects and passes air hose to No. 4.	Closes emergency cut-out cock on prime mover (fig. 10); disconnects and passes air hose to No. 5.
2		Opens drain cock on air brake emergency reserve air tank of gun.						Disconnects blackout lighting system from prime mover.		
3	When lunette is free from pintle, signals driver to move prime mover forward.	Place weight on muzzle to assist in lifting lunette and lowering trails.		Raise lunette from pintle of prime mover and lower trails when prime mover is moved forward.			Receive air hoses from Nos. 6 and 7 respectively and couple them to dummy couplings on gun trail.		Unlatches pintle.	
						Raise lunette from pintle of prime mover and lower trails when prime mover is moved forward.				

Table I.

631538—62 No. 1

Table IIA. Duties in Firing

Sequence	Chief of Section	Gunner	Assistant Gunner	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	Driver
1	Directs work of section personnel throughout all sequences.				Fuzes projectile and sets fuze.	Assists No. 6 in carrying projectile to the piece.		Prepares powder charge.	Assisted by No. 3, carries projectile to piece. Returns loading tray to ammunition point.	Assists No. 2 in fuzing projectile.	Performs maintenance on vehicle or other duties as directed by chief of section.
2			Closes breech when No. 3 calls "Closed."	Assisted by No. 4, rams the projectile.		Places powder charge in chamber and calls "Close."	Assists No. 1 in ramming the projectile.	Passes powder charge to No. 3.			
3	If gunner's quadrant is used, lays for quadrand, assisted by the gunner.	Lays howitzer for deflection and quadrant and announces "Ready." If gunner's quadrant is used, assists chief of section to lay for quadrant.	Primes the howitzer and calls "Set."								
4	Insures personnel are clear of path of recoil of tube.		After gunner announces "Ready" attaches the lanyard.								
5	Raises hand to indicate howitzer is ready to fire. On command of executive drops arm.		When chief of section drops arm, fires the howitzer.								
6			Opens breech, removes firing mechanism and replaces primer. Cleans breechblock and breech recess. Cleans primer vent and primer seat.	Swabs powder chamber: Inspects chamber and bore and announces "Bore clear."							

631838—62 No. 3

Table VII. Inspection Duties and Maintenance After Operation

Sequence	Chief of section	Gunner	AG	No. 1	No. 2	No. 3	No. 4	No. 5	Nos. 6 and 7	Driver
1	Commands INSPECT EQUIPMENT. Supervises detailed inspection and maintenance of gun in all sequences.	Inspects for presence of all sighting and fire control equipment; cleans, secures, and, to the extent that he is authorized, lubricates sighting and fire control equipment.			Inspects for presence and security of spade, handspike, and rammer staff sections on right trail, and cleans them if necessary.		Inspects for pressure and security of jack handles on right shield and cleans them if necessary.	Removes, cleans, lubricates, and returns aiming posts. Inspects for presence and security of aiming post lights.	As directed by the chief of section may assist prime mover driver in inspection and maintenance or perform other duties as directed by the chief of section.	Performs *after operation* duties as prescribed for his vehicle, assisted by cannoneers Nos. 6 and 7, when so directed by chief of section.
2	Inspects tools, accessories, and equipment for completeness and condition.									
3	Inspects ammunition for lot number, complete rounds, and general condition.	Assisted by No. 1, inspects tires and wheels of gun for damage and loose and missing parts; tests air pressure of tires and corrects it if necessary.		Assists gunner in inspecting tires and wheels and in verifying correct air pressure.	Removes and cleans light system equipment and stores it in section chest.					
4		Removes breech section of gun cover.						Inspects fastenings and general condition of gun cover.		
							Remove front section of gun cover.			
5	Inspects recoil system for signs of leakage and supervises establishment of the correct oil reserve (TM 9–331A).	Inspects shield fastenings.	Removes, cleans, oils, and replaces breech mechanism, assisted by section personnel as directed by chief of section.	Clean gun.			Obtains sponge, bucket, and cleaning and preserving materials.	Inspects muzzle cover and blackout lights for condition and serviceability.		
							Clean gun.			
6	Verifies the presence of and makes current entries in gun book, trip ticket, and other required documents.	Inspects bore and breech mechanism after cleaning.	Inspects brake lines and connections for condition and security.	Inspects handbrakes and wheels for damage and loose or missing parts.	Lubricates gun. See LO 9–331.	Lubricates gun as prescribed in LO 9–331.		Inspects, cleans, and cares for ammunition.		
7	Verifies that there is an ample supply of emergency rations, oil, water, and gasoline.	Checks the contents of the section chest, and inspects for condition of chest and contents.			Inspects carriage for loose or missing nuts, bolts, rivets, and broken welds, looks for excess grease or oil under carriage.	Inspects the firing jack and traveling lock, cleaning them if necessary.	Properly stores unused cleaning and preserving materials.			
8		Replace breech section of gun cover.			Cleans, lubricates, and returns fuze setter to section chest.	Replace front section of gun cover.				
9	Receives reports from members of the section as they complete inspection and maintenance operation.	Reports, "Gunner ready."	Reports, "AG ready."	Reports, "No. 1 ready."	Reports, "No. 2 ready."	Reports, "No. 3 ready."	Reports, "No. 4 ready."	Reports, "No. 5 ready."	Report, "No. (so-and-so) ready."	Reports, "Driver ready."
10	Reports to battery executive when section personnel have completed their duties, "Sir, No. (so-and-so) in order," or reports any defects which the section cannot remedy without delay.									

631538—62 No. 7

Table VI. Inspection Duties During Halt

Sequence	Chief of section	Gunner	AG	No. 1	Nos. 2 to 7 inclusive	Driver
1	Commands PERFORM HALT INSPECTION. Supervises inspection and maintenance at halt. Insures that personnel remain on the offroad side of the vehicle except for performance of necessary inspection duties	Inspects for presence, condition, and security of sighting equipment, gun cover, staff sections, aiming posts, trail handspikes, jack float, loading tray, spades, and spade keys.	Inspects coupling of gun to prime mover.	Inspect tires and wheels. (Inspects tires for wear, bruises, cuts, stones in treads, and for correct air pressure. Inspects wheels for loose or missing nuts, hubcap screws, valve caps, and for overheated wheel bearings and wheel drums.)	Perform duties as prescribed by chief of section.	Performs *at halt* duties as prescribed by the appropriate technical manual.
2			Inspects trail lock link and latch for condition and fastening.			
3			Inspects connection, functioning, and mounting of light system.			
4			Inspects brake lines and connection.			
5	Reccives reports of personnel upon completion of their duties.	Reports, "Gunner ready."	Reports, "AG ready."	Reports, "No. 1 ready."	Reports, "No. (so-and-so) ready."	Reports, "Driver ready."
6	Reports to battery executive when inspection is completed, "Sir, No. (so-and-so) in order," or reports any defects that the section cannot remedy without delay.					

Table VI.

Table V. Inspection Duties Before March

Sequence	Chief of section	Gunner	AG	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	Driver
1	Commands PERFORM BEFORE MARCH INSPECTION. Supervises inspections by members of the gun section in all sequences.	Inspects condition, completeness, contents, and security of section chest.			Verifies presence and security of spade, handspike, and rammer staff sections on right trail	Verifies presence and security of spade, handspike, spade keys, and rammer staff sections on left trail, together with the firing-jack float and the loading tray.	Verifies condition and security of sponge and bucket, and presence of sufficient supply of cleaning and preserving materials.	Assists ammunition corporal in verifying presence, condition, and proper loading of ammunition in section during all sequences in which he is not otherwise engaged.	Assists the prime mover driver in inspection and maintenance of his vehicle when directed to do so by the chief of section. Load ammunition as directed.		Performs *before operation* duties as prescribed in TM 21-305, assisted by Nos. 7 and 8 when so directed by chief of section.
2	Verifies that gun is properly coupled and brake lines connected.		Inspects brake lines and connections for serviceability and security.	Tests adjustment of handbrakes; inspects after coupling to see that brakes are released.	Verifies presence, condition, and proper loading of ammunition in section						
3	Verifies that handbrakes are released.	Remove rear section of gun cover.		Inspects fastenings and general condition of rear cover.		Remove front section of gun cover.		Inspects fastenings and general condition of muzzle cover and front section of gun cover.			
4	Inspects recoil system for signs of oil leakage and inspects oil index to insure that a proper reserve of oil is present.	Inspects condition and security of sighting and fire control equipment, including telescope mount.	Inspects breechblock firing mechanism, powder chamber, and bore for cleanliness, lubrication, and freedom from foreign matter.			Inspects the firing jack and the traveling lock for presence, security, and condition of all parts.	Verifies presence and security of jack handles on the right shield.	Verifies presence and completeness of aiming posts and aiming post lights.			
5	Verifies presence of proper supply of gasoline, oil, water and emergency rations.	Assists battery mechanic in servicing recoil system if necessary.						Verifies presence and serviceability of blackout lighting system.			
6	Verifies presence of technical manuals and lubrication orders for prime mover and gun, trip ticket, driver's accident report form, vehicle identification card, and gun book.										
7	Inspects loading of section equipment for completeness and security.	Inspects tires and wheels for damage and loose or missing parts; tests air pressure of tires and corrects it if necessary, assisted by No. 1.		Assists gunner in testing tire pressure and assists in correcting it if necessary.							
8	Inspects ammunition for lot number, condition, and stowage.	Replace rear section of gun cover.				Replace front section of gun cover.					
9	Causes air brakes to be tested. Verifies security of traveling lock and trail lock.		Inspects condition and fastening of trail lock, verifies that lunette is secure in pintle and that pintle latch is closed and locked.	Inspects to insure that all gun cover fastenings are secured properly.				Inspects to insure that all gun cover fastenings are secured properly.			
10	Receives reports of personnel of his section upon completion of their duties in inspection.	Reports, "Gunner ready."	Reports, "AG ready."	Reports, "No. 1 ready."	Reports, "No. 2 ready."	Reports, "No. 3 ready."	Reports, "No. 4 ready."	Reports, "No. 5 ready."	Reports, "No. 6 ready."	Reports, "No. 7 ready."	Reports, "Driver ready."
11	Reports to battery executive when section personnel have completed their duties, "Sir, No. (so-and-so) in order," or reports any defects which the section cannot remedy without delay.										

S/S ch 2

FIELD MANUAL

155-MM HOWITZER, M1 TOWED

FM 6-81
CHANGES No. 2

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *26 July 1963*

FM 6-81, 28 March 1962, is changed as follows:

28. Number 5

* * * * *

b. Detailed Description of Duties.

(1) *Prepares powder charges.*

(*a*) *Type M3 (green bag).* The M3 (green bag) * * * with this charge (TM 9-1300-205). **When firing charges 3 and 4, the M3 (green bag) propelling charge is preferred over use of the M4A1 (white bag) propelling charge.**

(*b*) *Type M4 (white bag).* As rescinded by C 1, 21 Dec 62)

(*c*) *Type M4A1 (white bag).* **(Rescinded)**

* **This change supersedes C 1, 21 December 1962.**

By order of the Secretary of the Army:

EARLE G. WHEELER,
General, United States Army,
Chief of Staff.

Official:

J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

Distribution:

Active Army:

ACSI (2)	Seventh US Army (5)
DCSOPS (2)	EUSA (5)
DCSLOG (2)	Corps (3)
C/Ofs Res Comp (1)	Div (2)
CofEngrs (1)	Div Arty (5)
TSG (1)	Inf Bde (1)
CSigO (1)	FA Gp (2)
CofT (1)	FA Bn (1) except TOE: 6-115, 6-135, 6-165, 6-355 (10)
CofSptS (1)	
CRD (1)	
CINFO (1)	FA Btry (1) except TOE: 6-118, 6-137, 6-167, 6-357 (20); 6-501 (3)
TIG (1)	
ARADCOM (2)	USMA (50)
USAMC (5)	USAAMS (1,070)
MDW (5)	

NG: State AG (3); units org under fol TOE: 6-100, 6-115 (3); 6-116, 6-118, 6-401 (2); 6-425 (3); 6-426, 6-427, 6-501, 7-1, 17-1 (2).

USAR: Div (2); Div Arty (5); FA Gp (2); FA Bn (1) except TOE: 6-115, 6-135 (10); FA Btry (1) except TOE: 6-118, 6-137 (20); 6-501 (3).

For explanation of abbreviations used, see AR 320-50.

☆ U. S. GOVERNMENT PRINTING OFFICE: 1963— 700526/5418C

515 c 2

FM 6–81
C 1

FIELD MANUAL
155-MM HOWITZER, M1
TOWED

FM 6–81
CHANGES No. 1

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C., *21 December 1962*

FM 6–81, 28 March 1962, is changed as follows:

28. Number 5

* * * * * * *

b. Detailed Description of Duties.

(1) *Prepares powder charges.*

(*a*) *Type M3 (green bag).* The M3 (green bag) * * * with this charge (TM 9–1300–205). Only M3 charges should be used when precision or calibration data is required. The M3 charges closely approximate the velocities prescribed in the firing tables and produce less dispersion than the M4A1 charges.

(*b*) *Type M4 (white bag).* (Rescinded)

(*c*) *Type M4A1 (white bag).* Type M4A1 (white bag) * * * can be prepared. Type M4A1 charges, except charge 6, should not be used when precision fire is desired. Charges 3 and 4 fire approximately 20 f/s higher than the same M3 charges and 10 f/s for higher charge 5. All charges, except charge 6, produce greater dispersion than the M3 charges.

* * * * * * *

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By Order of the Secretary of the Army:

EARLE G. WHEELER,
General, United States Army,
Chief of Staff.

Official:

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6–167 (20)
6–357 (20)
6–501 (3)
USMA (50)
USAAMS (1070)

NG: State AG (3); units org under fol TOE: 6–100 (3), 6–115 (3), 6–116 (2), 6–118 (2), 6–401 (2), 6–425 (3), 6–426 (2), 6–427 (2), 6–501 (2), 7–1 (2), 17–1 (2).

USAR: Units—Div (2), Div Arty (5), FA Gp (2), FA Bn (1) except TOE: 6–115 (10), 6–135 (10), FA Btry (1) except TOE: 6–118 (20), 6–137 (20), 6–501 (3).

For explanation of abbreviations used, see AR 320–50.

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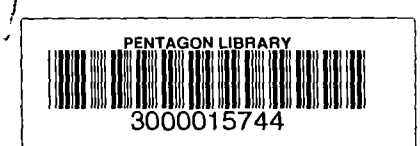
Table II. Prepare for Action

Sequence	Chief of Section	Gunner	AG	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7
1	Supervises work of all members of section throughout all sequences.		Unload ammunition, tools, and accessories. Arrange them in orderly and convenient manner.							
2			Unlatches right trail handspike support spring lever.	Unlatches left trail handspike support spring lever.						Removes trail retainer pin.
3			Assisted by No. 2, removes right spade from traveling position and places it near spread position of right trail.	Assisted by No. 3, removes left spade from traveling position and places it near spread position of left trail.	Assists AC in removing right spade from traveling position and places it near spread position of right trail.	Assists No. 1 in removing left spade from traveling position and places it near spread position of left trail.	Removes right trail handspike and passes it to No. 6.	Removes left trail handspike, passes it to No. 7, and loosens spade keys.	Unlocks trail lock.	
									Receives right trail handspike from No. 4.	Receives left trail handspike from No. 5.
4								Removes spade keys from left trail and places one on each trail in front of trail lock.	Inserts handspike in handspike socket on spade end of right trail.	Inserts handspike in handspike socket on spade end of left trail.
5	Places himself between trails, facing to the rear, grasps firing jack float and commands SPREAD.		Assists No. 6 in spreading right trail to fully open position.	Assists No. 7 in spreading left trail to fully open position.	Assists No. 6 in spreading right trail.	Assists No. 7 in spreading left trail.	Assists No. 6 in spreading right trail.	Assists No. 7 in spreading left trail.	Assisted by AG Nos. 2, 4, spreads right trail.	Assisted by Nos. 1, 3, and 5, spreads left trail.
	Places firing jack float outside left trail.									
6						Places firing jack float under jack with slot to front.			Removes loading tray from retainer on top of trail and places it to the right of right trail or as directed by chief of section.	
	Locks right spade in firing position with spade key.	Locks left spade in firing position with spade key.	Assisted by No. 2 raises right spade into firing position on trail before trail is lowered, then lowers trail.	Assisted by No. 3, raises left spade into firing position on trail before trail is lowered, then lowers trail.	Assists AG in raising right spade into firing position.	Assists No. 1 in raising left spade into firing position.	Assists No. 6 in holding up right trail.	Assists No. 7 in holding up left trail.	Assisted by chief of section and No. 4 holds up right trail while spade is placed in firing position.	Assisted by Gunner and No. 5, holds up left trail while spade is placed in firing position.
7	Verifies direction of fire and commands MARK TRAILS.								Marks right spade pit.	Marks left spade pit.
8			Assists No. 6 in partially closing right trail.	Assists No. 7 in partially closing left trail.	Assists No. 6 in partially closing right trail.	Assists No. 7 in partially closing left trail.	Assists No. 6 in partialy closing right trail.	Assists No. 7 in partially closing left trail.	Assisted by AG Nos. 2 and 4 partially closes right trail.	Assisted by Nos. 1, 3, and 5, partially closes left trail.
9					Places fuze setter and fuze wrench conveniently near ammunition.			Removes blackout lighting system and places it with section equipment.	Digs right spade pit.	Digs left spade pit.
			Remove rear section of gun cover.			Remove front section of gun cover.				
				Folds gun cover and places it 3 feet to right of right wheel.			Obtains jack handls from supports on right shied and places them on the groud in front of the float.	Folds gun cover and places it 3 feet to right of right wheel.		
10			Assists No. 6 in seating right spade in pit.	Assists No. 7 in seating left spade in pit.	Assists No. 6 in seating right spade in pit.	Assists No. 7 in seating left spade in pit.	Assists No. 6 in sating right spade in pit.	Assists No. 7 in seating left spade in pit.	Assisted by AG, Nos. 2 and 4, seats right spade in pit.	Assisted by Nos. 1, 3, and 5, seats left spade in pit.
11		M1A1 Traverses, elevates, or depresses tube to assist No. 4 in unlocking traveling lock.	Places lanyard, spare firing mechanism, vent cleaning tool, primer seat cleaning reamer, waste, and oiler on right trail 6 inches in rear of axle.	Inspects spade keys and seats them with sledge if necessary.	Assists preparing ammunition.	M1A1 Removes firing jack travel locking lever.	M1A1 Removes traveling lock pin as gunner manipulates elevating handwhed. Lowers traveling lock to firing position.	Removes muzzle cover and places it on gun cover.	Replaces right trail handspike in bracket.	Replaces left trail handspike in bracket.
							M1A2 Removes firing jack locking pin.			
12			Unlocks percussion hammer locking pin, locks hammer in open position, removes firing mechanism and places it on right trail. Opens breach.	Places swabbing sponge, burlap, and pail of water just forward of spade along inner side of left trail.		M1A1 Lowers firing jack rack plunger far enough for No. 4 to remove firing jack housing bottom cover.	M1A1 When No. 3 has lowered firing jack rack plunger, removes firing jack housing bottom cover.	Assembles aiming posts, places them on gun cover, and sets them out when so directed by chief of section.		Assembles four sections of rammer staff and bore brush and places on gun cover to right of gun with staff to rear.
						M1A2 Assists No. 4 in releasing firing jack from traveling position and placing it in firing position.	M1A2 Assisted by No. 3, releases firing jack from traveling position and secures it in firing position.			
13			Examines and cleans primer vent, breechblock, and powder chamber.	Assembles loading rammer head to two sections of rammer staff and places it beside trail to left of his post.		M1A1 Continues to lower rack plunger until ball at lower end engages socket on firing jack float.	M1A1 As rack plunger is lowered, alines float so that ball at lower end of plunger engages socket on firing jack float.	Assists preparing powder charges.	Lays telephone wire from gun to executive's post and lays other lines as directed.	Assists preparing ammunition.
		M1A2 Traverses, elevates, or depresses tube to assist No. 4 in unlocking traveling lock.					M1A2 Removes traveling lock pin as gunner manipulates elevating handwheel. Lowers traveling lock to firing position.			
14		Removes panoramic telescope from case and seats it in telescope mount.	Secures two firing mechanisms from right trail: inspects, cleans, and oils them.			M1A1 Assisted by No. 4, raises firing jack float into position on end of jack plunger and rotates float 90° counterclockwise, which leaves beveled edge of float to the rear.	M1A1 Assists No. 3 in raising firing jack float into position on end of jack plunger and in rotating float. Inserts jack handles in their sockets in the ratchet case.		Assists preparing ammunition.	
						M1A2 Lowers firing jack plunger until ball at lower end of plunger engages socket on firing jack float.	M1A2 As firing jack plunger is lowered, alines float so that ball at lower end of plunger engages socket on firing jack float.			
15		Uncovers telescope mount bubbles; matches elevation indexes on telescope mount; sets rotating head index at zero; and levels mount by centering bubbles.	Prepares primers for firing.			M1A1 Assists No. 4 in jacking gun up until firing jack key can be inserted in housing.	M1A1 Assisted by No. 3 jacks gun up until firing jack key can be inserted in housing.			
						M1A2 Assisted by No. 4 raises float into position on end of plunger and rotates float 90° counterclockwise, which leaves beveled edge of float to the rear.	M1A2 Assists No. 3 in raising float into position on end of jack plunger and in rotating float.			
16		Lowers and fastens top left shield if aiming point is obstructed. Closes drain cock to air emergency reserve tank.				M1A1 Lowers gun until rack plunger contacts the firing jack key.	M1A1 Inserts firing jack key and directs No. 3 to lower gun until rack plunger contacts firing jack key.			
						M1A2 Assists No. 4 in jacking gun up to limit of plunger travel.	M1A2 Assisted by No. 3 jacks gun up to limit of plunger travel.			
17						M1A2 Locks plunger in firing position.	M1A2 Manipulates ratchet so No. 3 can lock plunger in firing position.			
18		Alines aiming posts if directed by chief of section.		Assisted by No. 3 inspects powder chamber and bore. Cleans if necessary.		Passes jack handle to No. 4.	Receives jack handle from No. 3 and replaces both jack handles on shield.			
						Assists No. 1 in cleaning bore if necessary.				
19	Verifies that gun is prepared for action and reports to executive, "Sir, No. (so-and-so) in order," or reports any defects that the section cannot remedy without delay.									

Sequence	Chief of section	Gunner	AG	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7
1	Verifies that the gun is not loaded and supervises the work of all members of the section throughout all sequences.	Puts gun in center of traverse and elevates to approximately 400 mils.	Inspects the chamber to see that the bore is clear.	Disassembles rammer staff. Places loading rammer head in section chest. Fasten rammer staff sections on left trail.	Places fuze setter and fuze wrench in section chest.		Removes jack handles from right shield and passes one to No. 3.	Replaces aiming posts in covers and replaces them in traveling position on right trail.	Picks up wire from executive's post and picks up other wire as directed.	Disassembles rammer staff and replaces it in traveling position. Places bore brush in section chest. Assists in preparing and loading ammunition.
						Receives jack handle from No. 4.				
2		Sets all scales of the panoramic telescope at zero, and covers telescope mount bubbles.	Closes breech. Seats firing mechanism and places spare mechanism on right trail.		Assists in preparing ammunition for loading.	M1A1 Assists No. 4 in raising gun from firing jack key.	M1A1 Assisted by No. 3, raises gun from firing jack key.			
						M1A2 Assisted by No. 4, disengages firing jack locking plunger from locked position.	M1A2 Manipulates ratchet so No. 3 can disengage firing jack locking plunger.			
3		Removes telescope from mount and replaces it in case.	Locks the percussion hammer locking pin with hammer raised.				M1A1 Removes firing jack key and replaces it in its carrying bracket.	Assists in preparing and loading ammunition.	Assists in preparing and loading ammunition.	
						M1A2 Assists No. 4 in lowering gun onto wheels, removing firing jack float, raising plunger to traveling position, and securing firing jack in traveling position.	M1A2 Assisted by No. 3, lowers gun onto wheels, removes firing jack float, raises plunger to traveling position, and secures jack in traveling position.			
4		Raises top portion of left shield.	Prepares primers for traveling.			M1A1 Assists No. 4 in lowering gun onto wheels and removing firing jack float from firing jack rack plunger.	M1A1 Assisted by No. 3, lowers gun onto wheels and removes firing jack float.			
							M1A2 Replaces firing jack locking pin.			
5		Traverses, elevates, and depresses the gun to assist No. 4 in engaging and locking the traveling lock.	Replaces lanyard, vent cleaning tool, primer seat cleaning rammer, spare firing mechanism, waste, and oiler in section chest.				M1A1 Raises traveling lock and connects it to the cylinder yoke, directing the gunner in manipulating the elevating and traversing handwheels.			
6						M1A1 Hands jack handle to No. 4. Raises rack plunger and replaces firing jack housing bottom cover.	Replaces jack handles on right shield.			
						M1A2 Hands jack handle to No. 4.				
7						M1A1 Raises rack plunger to traveling position and replaces firing jack travel locking pin.	M1A2 raises traveling lock to traveling position, directs gunner to traverse, elevate, or depress the gun as required to insert lock pin, and inserts lock pin.			
8	Verifies that traveling lock has been properly secured.			Removes spade keys and places them in holder on left trail.		Replaces jack float in brackets on left trail.				
9	Commands TRAILS UP when spades are ready to be removed. Commands CLOSE when trails are ready to be closed. Guides float on left trail into brackets on right trail.		Assists No. 6 in raising and closing right trail.	Assists No. 7 in raising and closing left trail.	Assists No. 6 in raising and closing right trail.	Assists No. 7 in raising and closing left trail.	Assists No. 6 in raising and closing right trail.	Assists No. 7 in raising and closing left trail.	Assisted by AG Nos. 2 and 4, raises and closes right trail.	Assisted by Nos. 1, 3, and 5, raises and closes left trail.
10			Assisted by No. 2, returns right spade to traveling position.	Assisted by No. 3 returns left spade to traveling position.	Assists AG in returning right spade to traveling position.	Assists No. 1 in returning left spade to traveling position.			Passes right trail handspike to No. 4.	Passes left trail handspike to No. 5.
							Receives right trail handspike from No. 6 and secures it in traveling position.	Receives left trail handspike from No. 7 and secures it in traveling position.		
11				Obtains rear section of gun cover.				Replaces muzzle cover on gun and obtains front section of gun cover.	Locks trail lock.	Replaces trail retainer pin after trail is locked.
12		Replace rear section of gun cover.						Attaches blackout lighting system.		
		Load unexpended ammunition, tools, and accessories.				Replace front section of gun cover.				
13		Verifies that drain cock on air emergency reserve tank is closed. Releases left handbrake.	Releases right handbrake.			Take places at trail handles.				
14	Signals prime mover driver to move vehicle so that lunette is over the pintle.	Assist in raising trails by placing their weight on the muzzle.				Raise the trails				
15		Lower lunette upon pintle.				Latches and secures pintle.				
16							Unfastens emergency air brake hose from dummy coupling on trail and passes it to No. 6.	Unfastens service air brake hose from dummy coupling on trail and passes it to No. 7.	Receives service air brake hose from No. 4 and fastens it in receptacle on prime mover.	Receives emergency air brake hose from No. 5 and fastens it in receptacle on prime mover.
17									Opens service cutout cock on prime mover.	Opens emergency cutout cock on prime mover.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